SOUTH SULAWESI REGIONAL
OFFICE OF THE MINISTRY
OF AGRICULTURE

JAPAN INTERNATIONAL
COOPERATION AGENCY/JICA

SOUTH SULAWESI REGIONAL AGRICULTURAL DEVELOPMENT PLANNING / ATA 140 — PROJECT

THE FINAL REPORT OF

PHASE III

(JUNE 1979 — JUNE 1982)

JUNE 1982

THE RADP/ATA—140 SOUTH SULAWESI PROJECT TEAM
IN UJUNG PANDANG

INDONESIA-JAPAN TECHNICAL COOPERATION PROJECT

SOUTH SULAWESI REGIONAL
OFFICE OF THE MINISTRY
OF AGRICULTURE

JAPAN INTERNATIONAL
COOPERATION AGENCY/JICA

SOUTH SULAWESI
REGIONAL AGRICULTURAL DEVELOPMENT
PLANNING / ATA 140 — PROJECT

THE FINAL REPORT OF

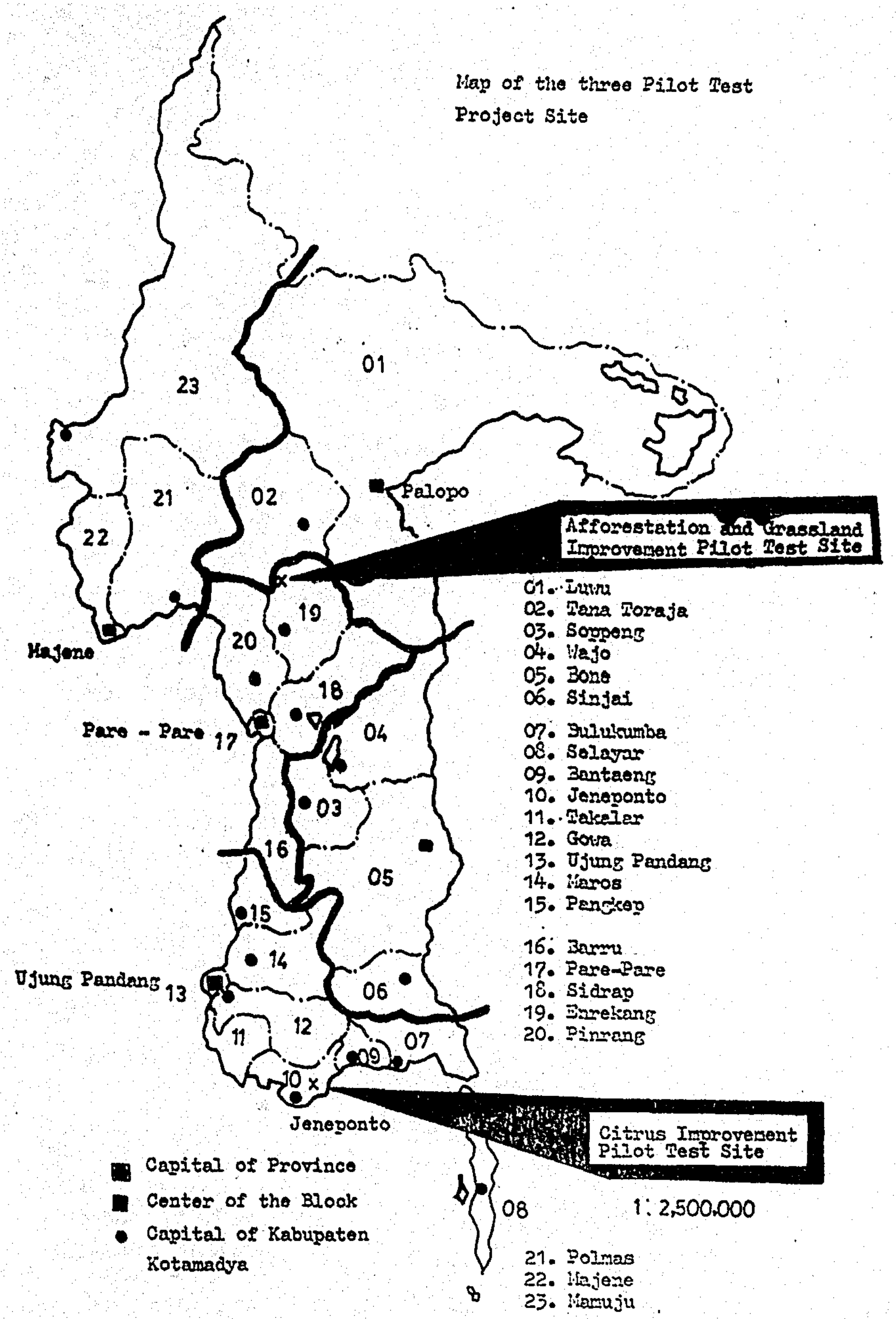
PHASE III

(JUNE 1979 — JUNE 1982)

JUNE 1982

THE RADP/ATA—140 SOUTH SULAWESI PROJECT TEAM
IN UJUNG PANDANG

INDONESIA-JAPAN TECHNICAL COOPERATION PROJECT



Map of the three Pilot Test Project Site
Afforestation and Grassland Improvement Pilot Test Site
Citrus Improvement Pilot Test Site
Palopo
Majene
Pare - Pare
Ujung Pandang
Jeneponto
01
02
03
04
05
06
07
08
09
10
11
12
13
14
15
16
17
18
19
20
21
22
23
01. Luwu
02. Tana Toraja
03. Soppeng
04. Wajo
05. Bone
06. Sinjai
07. Bulukumba
08. Selayar
09. Bantaeng
10. Jeneponto
11. Takalar
12. Gowa
13. Ujung Pandang
14. Maros
15. Pangkep
16. Barru
17. Pare-Pare
18. Sidrap
19. Enrekang
20. Pinrang
21. Polmas
22. Majene
23. Mamuju
Capital of Province
Center of the Block
Capital of Kabupaten Kotamadya
1 : 2,500,000

THE FINAL REPORT OF PHASE III

C O N T E N T S

P R E F A C E .

This report named " Final Report of Phase III " is the last report of our project, having lasted five and a half years from December 25, 1976 through June 23, 1982. So far, we have published many reports as listed in the List of Publications in this report; therefore we have compiled this report avoiding duplication with previous reports.

We would like to explain briefly the features of this report as follows :

The principal part of this report is the one on the progress of Pilot Tests in three fields : Citrus, Grassland and Afforestation including the technical reports and the operational plan for future use. We expect that these reports will be fully utilized to achieve a successful handing over of the project to the Indonesian side and a consequently the pilot tests will make a remarkable contribution to the regional agricultural development.

This is also what we call a " Feasibility Study Report " in the R/D. Actually, due to the fact that we could hardly be given concrete proposals of projects from the local people in the two kabupaten-s, namely Enrekang and Jeneponto, and it was too early and rather difficult to obtain the precise technological data developed by the pilot tests, we have made the studies on the economic and financial justification of the model projects in the three fields. And we hope that these studies will become effective and practical guidance for the local planners when they will have an actual need of projects in the future.

Moreover, this report is considered to be an annual report for the period from July 1981 to June 1982 because this report includes information of the project activities in that period.

This report also contains a chapter on Regioanl Agricultural Development in Indonesia, which provides basic and beneficial guidelines for the Planners, the summary of the Master Plan for Block III-area, report on the farmers' training course held in Enrekang and Jeneponto and the other necessary information relating to the project activities.

Finally, we wish to express our deep gratitude for the efficient and steady assistance given by officials of both the Indonesian and Japanese Governments to our project team, and we sincerely hope that the result of our project will contribute to the strengthening of the bridge of friendship between our two countries, Indonesia and Japan.

thening of the bridge of friendship between our two countries, Indonesia and Japan.

Ujung Pandang, June 1982.

The South Sulawesi Regional
Agricultural Development Planning/
ATA-140 Project Team,

I. Suzuki

A.P. Hutabarat, Manager

Isao Suzuki, Advisor

Momo Syamsuddin, Co-manager

Koichiro Katsurai,
Team Leader.

CHAPTER I. INTRODUCTION

Koichiro Katsurai
Mono Syamsuddin
Mitsuhiko Ota

Contents

CHAPTER I. INTRODUCTION

I-1. *Brief History of the Project*

I-1-1. Background.

With the progress of the various kinds of agricultural development projects; it has been becoming more and more necessary to strengthen the side of planning and formulation in order to strive for the efficient implementation of project. Moreover, in order to expect the balanced development among different areas and sector, it is essential to put various projects into operation step by step in conformity with the integrated regional plan of agricultural development. In this circumstance, the agricultural ministry of the Indonesian Government has made an effort to reinforce the planning function with the establishment of the regional office (KANWIL) and also has recognized that the improvement of planning method is necessary in the first place for the effective operation of such regional office.

Therefore, the Indonesian Government requested the Japanese Government for a technical cooperation to establish a planning project in South Sulawesi as one of the ATA-140 projects such as those in South Sumatera, East Kalimantan and East Java.

Upon the request, the preliminary survey team for the South Sulawesi Regional Agricultural Development Planning was sent by JICA from 26 November to 12 December 1975.

Contents of ATA-140 at that juncture were as follows :

"(1). Objectives of the project :

The cooperation project for the Regional Agricultural Development Planning : ATA-140 consists of two phases :
The Project Planning Phase and the Project Preparation Phase. For the Project Planning Phase a period less than 18 months and for the Project Preparation Phase a period of less than 12 months are allocated.

The main objectives of the project may be outlined as below :

1). To cooperate in the improvement in the method and techniques of regional agricultural development planning;
2). To cooperate in the planning of a model regional agricultural development plan and in the implementation of an experimental project;
3). To cooperate in the preparation of a guide line necessary when the agricultural development project formulated above is implemented by the related agricultural authorities or the provincial

government alone and for adjustments in the case of requesting cooperation from the foreign government concerned; and

4). To cooperate in the improvement of the techniques of preparing plans necessary for formulating those projects in various subsectors of agriculture and also in project evaluation techniques.

This regional agricultural development planning covers agriculture, forestry, fisheries and livestock.

(2). Major operations of the project :

The major operations of this cooperation project may be outlined as below :

1). The South Sulawesi Regional Development Plan (5-years Development Plan of South Sulawesi Province) has already been formulated by BAPPEDA of South Sulawesi. This project is to examine whether the plan has been formulated appropriately and whether there are defects in implementation;

2). In addition to various cooperation projects with foreign countries, there are national and provincial projects are in progress. This project is to examine whether these projects are appropriately planned and implemented; and

3). While providing technical guidance and advice for those provincial and local officials of South Sulawesi who are engaged in the implementation of experimental projects in Kabupatens of Jeneponto and Takalar, which are to serve as a guiding line for the South Sulawesi Regional Development Plan, this project is to improve the technical capability regarding the method of planning, method of re-examining existing plans and the method of implementing projects under these plans."

On 4 May 1976, the Record of Discussions was signed in Jakarta between the Japanese Agricultural Survey Team and the authorities concerned of the Government of Indonesia. Regarding the objectives and the operation, the major change from the above-mentioned contents was that the experimental projects were excluded. (Please note that the idea of experimental project revived later and has realized as Pilot Test in Phase III). The objectives and the scope of Activities mentioned in the R/D were as follows :

"1. Objectives.

This project, with a view of contributing to the promotion of regional agriculture, is intended to make an over-all review of the plans for the development of agriculture in the Province of South Sulawesi, to give advisory guidances on them, to possibly improve methods and techniques of planning the development of regional agriculture and thereby to improve the planning capability of the officials in charge.

2. Scope of Activities.

(1). The project consists of the following four (4) stages :

- survey and analysis concerning agriculture in the Province of South Sulawesi;
- review of the Regional Development Plan formulated by the BAPPEDA and of other existing projects, and recommendation thereon;
- Drawing-up of sector plans in conformity with the Plan mentioned in Paragraph (2);
- Drawing-up of the implementation plans including project preparation and feasibility study for agricultural development projects in certain regencies in conformity with the said plans.

(2). Training activity will be carried out through all the stages of the project."

I-1-2. Phase I and Phase II (Dec. 1976 - June 1979).

The period of the technical cooperation mentioned in the R/D was thirty (30) months starting on the date of the arrival of the Japanese experts which was 25 December 1976. And this period of 30 months was divided into Phase I of 18 months and Phase II of 12 months. The main activity done in Phase I was making of a Master Plan and in Phase II the pre-feasibility studies were carried out in the Kabupaten-s of Enrekang and Jeneponto because the abovementioned two Kabupaten-s were chosen as " certain regencies " mentioned in R/D. The achievements in the period of Phase I and Phase II were shaped into the Final Report on Phase I in 5 volumes and Final Report on Phase II in 4 volumes which were highly appreciated by the persons concerned.

As for the result of these Phases I and II, the Japanese and Indonesian Joint Evaluation Team reported in June 1979 as follows :

" The results of evaluation may be outlined in the two points below :

1). The results of the project can be valued highly as a milestone of high practicality resulting from daily trial and error based on the actual condition of Indonesia. It is hoped that the results will be effectively utilized in future.

2). It seems thet the extention of the project period by about 30 months is desirable."

And this report submitted the plan for the pilot tests in the four fields of Reforestation, Grassland Improvement, Citrus Improvement and Model Shrimp Pond. (Model Shrimp Pond was not realized).

I-1-3. Phase III (June 1979 - June 1982).

Due to the result of the joint evaluation, the Extension Note was signed in Jakarta on 18 June 1979 and the Plan of Operation for the RADP/ATA-140 Project in South Sulawesi was signed in Jakarta on 27 July 1979. The period of technical cooperation extended for two years until 23 June 1981 and the Scope of Activities was mentioned in the plan of operation as follows :

" Scope of Activities :

1. Feasibility Studies.

A. The feasibility studies of three fields such as afforestation, grassland improvement and citrus improvement will be continued in both Kabupaten, Enrekang and Jeneponto, by using the precise data which will be obtained through pilot tests as mentioned below.

B. The master plan in Block III will be formulated by the Indonesian counterparts with appropriate advice of the project team-leader.

2. Transfer of Technology.

Through feasibility studies including pilot tests, methodology of project formulation and planning techniques will be transferred to Indonesian counterparts. Thus training programs comprising class-room training, seminar and on-the-job training for the counterparts will be stengthened.

3. Pilot Tests.

With a view to supplementing the pre-feasibility studies made in Phase II, the pilot tests of afforestation and grassland improvement in mountainous area, and citrus fruit improvement of sloping land in scarce rainfall area will be implemented.

The technical data obtained from these pilot tests will be fed-back to the project planning aimed at national use of sloping land and soil conservation.

The pilot tests are to be utilized also for technical training and demonstration purposes."

In the period of Phase III, the pilot tests has been established according to the plan of operation, but mainly due to the delay of the construction works, the project could hardly be completed within the fixed period. In such cisrcumstance, the JICA Technical Guidance Team had a series of talks with the Indonesian authorities concerned in June 1982, consequently both the Indonesian and Japanese Government have agreed to extend the period of technical cooperation for one more year until 23 June 1982.

In this connection, we have been making our best efforts to attain the anticipated purpose of the project so far.

I-2 CALENDAR OF THE ATA-140 PROJECT LIFE

YEAR / MONTH :		PROGRESS OF THE PROJECT :	REMARKS :
1974,	4	The first year of the second National Five Year's Plan.	1974, 4 - 1979, 4
1975,	4	RADP / ATA-140 South Sulawesi Project proposed to Japan.	
1975,	11	Preliminary survey conducted by JICA.	
1976,	5	Implementation survey conducted and the Record of Discussion signed by both authorities.	The R/D made valid at the date of expert's arrival in Indonesia.
1976,	12	Arrival of The Japanese experts' team in Indonesia and R/D made valid.	
1976,	12	The first Joint-Committee held in Jakarta.	Basic working plan agreed.
1976,	12	Donation of equipment and machinery began.	
1977,	1	The first Steering Committee held in Ujung Pandang.	
1977,	2	Data collection / data processing commenced by the Project team.	Project activities started.
1977,	2	The second Steering Committee.	
1977,	3	The first conference of Technical consultant board held at JICA, Tokyo.	
1977,	5	The second conference of Technical consultant board.	
1977,	6	Technical Guidance team dispatched by JICA for smooth implementation.	Headed by Dr. Shingo Ito.
1977,	6	The second Joint Committee.	
1977,	7	The third Steering Committee.	
1977,	7	The third conference of technical consultant board.	
1977,	8	Seminar for Regional planning held in Ujung Pandang.	Lecturer dispatched by JICA.
1977,	9	The fourth Steering Committee.	
1977,	10	Dispatch of short-term experts for many field began.	
1977,	10	Formulation of a Master Plan of a Regional Agricultural Development commenced by the Team.	

YEAR / MONTH :	PROGRESS OF THE PROJECT :	REMARKS :
1977, 12	The fifth Steering Committee.	
1978, 1	The sixth Steering Committee.	
1978, 1	The fourth conference of technical consultant board.	
1978, 2	The seventh Steering Committee.	
1978, 2	Technical Guidance Team dispatched by JICA instructed planning methods.	Headed by Koichi Baba.
1978, 2	The fifth conference of technical consultant board.	
1978, 4	The second seminar held in Ujung-Pandang.	Lecturer dispatched by JICA.
1978, 5	The first draft of a Master Plan of a Regional Agricultural Development in South Sulawesi formulated.	
1978, 6	The eighth Steering Committee.	
1978, 7	Technical Guidance team dispatched by JICA.	Headed by Mr. Isao Suzuki.
1978, 7	The third Joint-Committee.	
1978, 7	The nineth Steering Committee.	
1978, 8	The tenth Steering Committee.	
1978, 9	The fourth Joint-Committee.	
1978, 12	The second draft of a Master Plan of Regional Agricultural Development started to be formulated by the team,	
1978, 12	Pre-feasibility study commenced in Kab. Jeneponto and Kab. Enrekang by the team.	
1979, 2	A Master Plan on South Sulawesi Regional Agricultural Development was published the Project Team.	(Joint Evaluation) Japanese side ; headed by Mr. Nobuharu Sasano.
1979, 3	Evaluation survey team dispatched by JICA and Joint-Evaluation implemented. A Master Plan highly appreciated by the Joint-Evaluation Team, but the Project recommended two Years' prolongation, for the reason that the feasibility study for the two Kabupaten-s was not completed.	Indonesian side : Headed by Mr. Hendro Soewarno. There was no precise data at Kabupaten level for F/S
1979, 6	Experts' team back to Japan except the Team Leader, S. Kikkawa.	

YEAR / MONTH :	PROGRESS OF THE PROJECT :	REMARKS :
1979, 6	The R/D (Extention Note) signed on June, 18, a prolongation of the Project for two years based on the recommendation of the Joint-Evaluation Team, the activities of the project shifted to the implementation of the three Pilot Tests, to get the precise data, feasbility study of such three fields in Kab. Jeneponto and in Kab. Enrekang and to make a Master Plan of Block III Developmental Zone.	Three fields are;Citrus in Jeneponto, Grassland Improvement and Afforestation in Enrekang. Most of counterparts were also shifted to new person from the agencies concerned.
1979, 7	The Implementation and design survey Team dispatched by JICA and the Plan of Operation for new two years signed by both authorities concerned.	Some substancial problems were cleared; bridge and access road of 5 km. to the site in Kabupaten Enrekang and water scarecity in Kab. Jeneponto.
1979, 7	Engineering Survey Implemented for Model Infra. Construction at the Pilot Test site for 50 days.	
1979, 9	Provincial Budget available provided by the Provincial Administration for the construction of a Training Center.	
1979, 9	Installation of Bailey Bridge to the Project Site was requested to the D.P.U. of South Sulawesi.	
1979, 9	Purchase of the land for Citrus Pilot Test was authorized by the Provincial Administration.	Rp. 600,000/ha. three hectare purchased.
1979, 9	Water use right for the Citrus Pilot Test was authorized by the Irrigation Dep. of D.P.U South Sulawesi.	
1979, 10	Advisor and Liaison Officer arrived in Jakarta and in Ujung Pandang respectively.	Oct. 3rd, arrived in Jakarta.
1979, 10	Equipment proposal for F/Y 1979 submitted to JICA.	
1979, 10	Proposal for Model Infrastructure Construction submitted to JICA, Tokyo.	
1979, 11	Proposal for storage house construction submitted to JICA, Tokyo.	
1979, 12	Three Experts arrived in U. Pandang the first visit to the Project Site by three Experts.	Citrus, Grassland and Forestry. December 12, Arrived in Jakarta.

YEAR/ MONTH :	PROGRESS OF THE PROJECT :	REMARKS :
1980, 1	The Survey for the Master Plan of Block III started by the Block III Team.	
1980, 1	The 19th National Greening Festival held in Kabupaten Enrekang.	
1980, 1	General Survey and preparation of three pilot tests commenced by three experts.	
1980, 2	C-type house construction started in Kabupaten Jeneponto.	
1980, 2	Leader's Conference Held in Jakarta.	
1980, 2	Comparative study to the mountain of logging project in Central and East Java conducted by the Forestry Expert.	
1980, 2	Proposal for equipment, F/Y, 1980, submitted to JICA, Tokyo.	
1980, 3	Bailey bridge construction commenced by D.P.U of Kab. Enrekang.	
1980, 3	Model Infrastructure construction at the Citrus Pilot Test site in Jeneponto started.	Amount of contract : Rp.24,610,000,- from JICA
1980, 3	Storage house construction in Jeneponto by JICA started.	Rp 2,960,000,-
1980, 3	Equipment of first shipment F/Y, 1979 arrived in U. Pandang.	
1980, 4	Storage house in Kabupaten Jeneponto was completed.	
1980, 5	Storage house construction at the Project site in Kab. Enrekang started and completed at the end of this month by JICA	Transportation of construction materials depended on the horses. Completation of bridge delayed about six months.
1980, 5	Dormitary and classroom construction at the Project site in Kab. Enrekang started.	
1980, 5	Comparative study to the Afforestation Project in South Sumatera conducted by forestry expert.	

YEAR/ MONTH :	PROGRESS OF THE PROJECT :	REMARKS :
1980, 6	Bailey bridge to the Project site in Kab. Enrekang completed, but the schedule was delayed six months, so the other construction and the Pilot Test activities were very badly influenced by this fact.	
1980, 6	Road construction of 2.1 km. to the Project site in Kabupaten Enrekang started.	
1980, 6	Fundamental survey for three Pilot tests was almost finished and the revised plan of operation was made by the Project team.	The result was shortage of cooperational period to achieve the contents of the plan of operation.
1980, 7	Road construction 2.1 km. to the Pilot Test site in Kabupaten Enrekang completed.	Hitherto experts and counterparts went to the Project site on foot.
1980, 7	Model Infrastructure construction at the Project site in Kab. Jeneponto completed. And the thanksgiving ceremony was held at the Project site.	Pilot Test activities made good progress from now.
1980, 7	Model Infrastructure construction at the Project site in Kabupaten Enrekang started.	
1980, 7	Equipment of second shipment, F/Y, 1979 arrived at Ujung Pandang.	
1980, 7	Technical Guidance Team arrived in U. Pandang. The Joint Committee was held in Jakarta, attended by the Technical Guidance Team as observer. Revised plan of operation was approved by the mission and Indonesian authorities concerned.	Led by Mr. Shoji Kanatsu. One years prolongation of the Project was recognized by both sides.
1980, 7	Annual Progrees Report, Phase III was published by the Project Team.	
1980, 8	The first Citrus contest was held at the Project site in Kab. Jeneponto.	To select the qualified mother tree.
1980, 9	Equipment of second shipment, F/Y 1979 arrived at the Project site.	
1980, 9	Budget proposal to buy four cars in Indonesia submitted to JICA.	Budget of F/Y, 1980.

YEAR / MONTH :	PROGRESS OF THE PROJECT :	REMARKS :
1980, 9	Detail explanations of the Project activities to BAPPENAS to get the local budget of F/Y, 1981 - 1982.	
1980, 9	Necessary counterparts for three pilot tests assigned completely.	
1980, 9	Comparative Study to the Padang Mengatas Animal Husbandry Project conducted by Grassland Improvement Expert.	
1980, 10	Instruction mission for the M/I construction arrived in U. Pandang.	
1980, 10	Advisor Mr. Suzuki and Liaison Officer Mr. Ota took a one month's home-leave.	
1980, 11	Dormitory and classroom at the Project site in Kab. Enrekang completed.	
1980, 11	Model Infrastructure construction at the Project site in Kab. Enrekang completed by JICA, and thanks-giving ceremony was held at the Project site.	Amount of contract Rp 42,444,000,-
1980, 11	Equipment of first shipment, F/Y, 1980 arrived in Ujung Pandang.	
1980, 11	Team Leader, Mr. Kikkawa returns to Japan for Medical Treatment.	
1980, 12	Equipment of second shipment, F/Y, 1980 arrived in Ujung Pandang.	
1981, 1	Seminar for Regional Planner from Kanwil Deptan through Indonesia held in Jakarta.	Lecturer dispatched by JICA.
1981, 2	Leaders' conference held in Tokyo by JICA.	
1981, 2	First draft of Feasibility Study of three fields were made by the Project team with assistance of short-term expert.	
1981 2	Road construction of 3.5 km. to the Project site of the Grassland Pilot Test in Kabupaten Enrekang started.	These construction were very much delayed, but the Pilot Test activities were almost implemented.

YEAR / MONTH :	PROGRESS OF THE PROJECT :	REMARKS :
1981, 3	Dormitory and classroom construction at the Project site in Kab. Jeneponto started.	
1981, 5	Construction of C type house at the Project site in Kabupaten Enrekang started.	
1981, 5	Master Plan of Block III started to be formulated by the Block III team.	
1981, 6	Technical Guidance Team arrived in U.Pandang. And the Project's executive bodies of both countries agreed on the extension of the R/D and the plan of operation for one year. The mission strongly recommended for the continuation of the Pilot Tests by the Indonesia side alone after the expiry of the Japanese cooperation.	Headed by Mr. Ken Uesugi. R/D (Extension Note) signed on June, 22, 1981. Follow-up of Citrus Development after expiry of the Project was strongly requested by the Bupati of Jeneponto.
1981, 6	New Team Leader, Mr. K. Katsurai arrived in U.Pandang as successor of Mr. Kikkawa.	
1981, 7	Forestry expert, Mr. T. Takaku and Grassland expert, Mr. F. Harada took a home leave for one month.	
1981, 7	Japanese film show held at Kanwil Deptan with cooperation of Japanese Consulate General in U.Pandang.	
1981, 8	The second citrus contest conducted by the Project Team.	
1981, 8	Comparative study to Lampung Tani-Makmur Project for Block III team conducted by Team Leader.	
1981, 9	New improved organization and work structure of Kanwil Deptan were authorized by the Ministry of Agriculture.	
1981, 9	Comparative Study to East Java and Bali Island cultivation conducted by Citrus expert.	
1981, 10	A Master Plan of Block III was completed by the Block III team.	

YEAR / MONTH :	PROGRESS OF THE PROJECT :	REMARKS :
1981, 10	Citrus expert, Mr. H. Miura took a home leave for one month.	
1981, 10	The first meeting of ATA-140 South-Sulawesi Project for smooth handing over to Indonesian side with officials concerned held at JICA jakarta office in Jakarta.	It was confirmed by Indonesian authorities and the Japanese expert team that the Feasibility study mentioned in R/D was not the feasibility study in its strict term.
1981, 11	Equipment of F/Y 1981 arrived in Ujung Pandang.	
1981, 12	Five central Government officials from agencies concerned were invited the observation tour to the three Pilot Test site by the Project team in Ujung Pandang.	To make them know the real condition of critical area and Pilot Test site.
1981, 12	The second meeting of ATA-140 South Sulawesi Project for smooth handing over to Indonesian side was held in U.Pandang with officials concerned. And outline of the Final Report of Phase III was explained to them.	
1981, 12	Comparative study of Bali-cattle to Bali Island conducted by Grassland expert.	
1982, 1	Proposal (A1-form) of expert on Citrus Development to follow-up the Pilot Test activities was submitted to the central Gevernment from Kanwil Deptan, South Sulawesi.	
1982, 1	C type house at the Project site in Kabupaten Enrekang was completed.	It took about eight months until completion.
1982, 1	Comparative study to the citrus advanced area in West Java conducted by Citrus expert.	
1982, 1	Operational Plan of three Pilot Test in future were explained to the agencies concerned by the Project team.	
1982, 2	The first farmers' training by a budget of EPLPP, Indonesia was implemented at the Project site in Kab. Enrekang and Kab. Jeneponto.	Sixteen farmers from Kab. Enrekang and fifteen farmers from Kab. Jeneponto joined this training for one month.

YEAR / MONTH :	PROGRESS OF THE PROJECT :	REMARKS :
1982, 2	Feasibility study by the Project team was completed with assistance of short-term expert.	
1982, 2	Leaders' conference held in Bangkok by JICA.	
1982, 3	Dormitory and classroom at the Project site in Kab. Jeneponto completed.	It took about one year until completion.
1982, 3	Formulation of the Final Report on Phase III made progress.	
1982, 3	Proposal of Budget for making Final Report of Phase III was submitted to JICA.	Rp 1,800,000,-
1982, 4	Draft of the Final Report of Phase III completed by the Project team.	
1982, 4	Explanation of the Final Report of Phase III to the central Gevernment and Provincial Government were implemented by the Project team.	
1982, 5	National election was held in Indonesia.	May 4, 1982.
1982, 5	Some arrangement of the three Pilot Test sites for handing over to the Indonesian side.	Equipment and field etc.
1982, 5	Seminar on Regional Planning for the planning officials from 23 Kabupaten-s, in South Sulawesi held in Ujung - Pandang.	Using the Subject and Drill Book for Regional Planning which is translated into Indonesian language by JICA. Lecturer dispatched by JICA
1982, 6	The Final Report of Phase III published by the Project team in U.Pandang.	
1982, 6	Joint-Committee held in Jakarta. The RADP / ATA-140 South Sulawesi Project was successfully handed over to the Indonesian agencies concerned.	
1982, 6	All Japanese expert of six members back to Japan on June 23, 1982.	

I-3 Contribution by Both Governments

I-3-1 Japanese Government

1.000 Rupiah
(1.000 US$)

	F/Y 76 - 78	79	80	81/82,6	Total :	%
Equipment and Machinery.	213,125 (341)	145,000 (232)	53,125 (85)	8,125 (13)	419,375 (671)	23.5
Training in Japan	26,250 (42)	3,125 (5)	18,437 (29.5)	17,000 (27.2)	64,812 (103.7)	3.6
Construction	5,000 (8)	-	72,974 (116.7)	-	77,974 (124.7)	4.4
Experts Service	528,125 (845)	112,500 (180)	224,712 (359.5)	210,281 (336.4)	1.075,618 (1,720.9)	60.4
Survey Team	90,625 (145)	28,125 (45)	17,125 (27.4)	8,125 (13)	144,000 (230.4)	8.1
T o t a l	863,125 (1,381)	288,750 (462)	386,373 (618.1)	243,531 (389.6)	1,781,779 (2,850.7)	100

* 1 US$ / 625 Rp. / 230 Yen.

Total Contribution : 1,781,779 thousand Rupiah.
(2,850.7) thousand US$

Phase I and Phase II (1976.12 - 1979.6) 863,125 thousand Rupiah.
(1,381) thousand US$

Phase III (1979.6 - 1982.6) 918,654 thousand Rupiah.
(1,469.7) thousand US$

I-3-2 Indonesian Government

1.000 Rupiah
(1.000 US$).

		79/80	80/81	81/82,6	Total
Citrus Pilot Test.	National Budget	-	12,655	15,075	27,730
	Regional Budget	21,000	39,360	-	60,360
Afforestation Pilot Test	National	7,954	8,365	18,268	34,587
	Regional	51,000	4,800	-	55,800
Grassland Pilot Test	National	17,840	34,544	41,123	93,507
	Regional	9,000	24,500	-	33,500
Block III	National	17,570	26,860	15,280	59,710
	Regional	20,000	-	-	20,000
Coordination of Pilot Test Activities	National	-	-	17,575	17,575
	Regional	-	-	-	-
Farmer's Training	National	-	-	20,000	20,000
	Regional	-	-	15,355	15,355
T o t a l	National	43,364	82,424	127,321	253,109
	Regional	101,000	68,660	15,355	185,015
Grand Total	-	144,364 (231)	151,084 (241.7)	142,676 (228.3)	438,124 (701)

* 1 US$ / 625 Rupiah.

Total Contribution of Phase III (1979.7 - 1982.6)	438,124	thousand Rupiah	100%
	(701)	thousand US$	
National Budget	253,109	thousand Rupiah	57.7%
	(405)	thousand US$	
Regional Budget	185,015	thousand Rupiah	42.3%
	(296)	thousand US$	

* We couldn't catch the local budget on Phase I and Phase II (1976. 12 - 1979. 6).-

I-4. List of Publications

I-4-1 English Publications during Phase I and Phase II, (Dec.1976-June.1979)

(1). A Master Plan on South Sulawesi Regional Agricultural Development (Final Report on Phase I, Volume I).

(2). The Present Situation & Problems of Agriculture in South Sulawesi (Final Report on Phase I, Volume II).

(3). Data of Agriculture in South Sulawesi Province (Final Report on Phase I, Volume III).

(4). A Guidance for the Planning on Regional Agricultural Development (Final Report on Phase I, Volume IV).

(5). Basic Maps for Planning on Regional Agricultural Development in South Sulawesi Province (Final Report on Phase I, Volume V).

(6). Result on the Studies on the Regional Agricultural Developments in South Sulawesi Province (Annual Report 1977, Volume I).

(7). Data and Information of the Agriculture in South Sulawesi Province (Annual Report 1977, Volume II).

(8). Report on Feasibility Study for Model Shrimp Pond in Jeneponto, South Sulawesi Province (Volume I & II).

(9). Record of Activities of the Project Team for 30 Months, 25 December-1976 - 24 June 1979 (Final Report on Phase II, Volume I).

(10). A Prefeasibility Study Report on the Improvement of Afforestation Grassland, Citrus and Brackish water fish ponds in specific KABUPATEN-S (Final Report on Phase II, Volume II).

(11) Agricultural Development Plan of Kabupaten Jeneponto, An Example (Final Report on Phase II, Volume III).

(12) Agricultural Development Plan of Kabupaten Enrekang, An Example (Final Report on Phase II, Volume IV).

(13) Comments on the Agricultural Development in Indonesia by Project Advisor : Yoshihisa MIKI.

(14) Report on Phase I & Phase II by Short Term Experts (Internal Report)

(Phase I) C O N T E N T S

1). Water Resources : Ryuichi TATSUMI Oct. 30 - Dec. 19, 1977.

2). Regional Planning: Yoshihiko OGAWA Nov. 30 - Dec. 29, 1977.

3). Socio-economic factors and farmers' needs : Hiroyuki NISHIMURA Dec. 15, 1977 - Feb. 14, 1978.

4). Organization of Farmers : Kanae MORINISHI Feb. 20 - March 25, 1978.

5). Marketing and Processing : Iwao NISHIYAMA Oct. 20 - Dec. 19, 1977.

6). Soil and Vegetation : Maasaki FUNADA Dec. 15, 1977 - Jan. 31, 1978.

7). Forest Land and Management : Hiroshi MURAI Jan. 27 - March 2, 1978.

8). Fishery Resources Development : Takeichiro KAFUKU Nov. 30, 1977 - Jan. 29, 1978.

9). Seminar on Estimation of Population and Labour Force : Terushi EGASHIRA August. 7 - 21, 1977.

(Phase II) CONTENTS

1). Marketing and Vegetables : Yoshio SHIRAISHI Sept. 12 - Nov. 11, 1978.

2). Water Resources : Tetsuro MIYAZATO May. 1, 1978 - March 31, 1979.

3). Geology : Kyoichi TANAKA Sept, 12 - Oct. 11, 1978.

4). Soil and Vegetation : Masaaki FUNADA, Noriaki SHIOJIRI Sept. 12 - Dec. 11, 1978 and Sept. 12 - Nov. 11, 1978.

5). Soil and Vegetation : Masaaki FUNADA, Sept, 12 - Dec. 11, 1978.

6). Forestation : Ryuichi TERUI Sept. 12 - Nov. 11, 1978.

7). Grassland Improvement : Shunichi Shoji Sept. 12 - Nov. 11, 1978.

8). Seminar on Establishment of the Optimum Plan of Regional Agricultural Production : Kazuo MUTO, March 24. - April 9, 1978.

(15) Reference : On South Sulawesi Regional Agricultural Development Planning / ATA-140 Project. (Internal Report)

CONTENTS

1). General Information of South Sulawesi Economics

2). Performance on the quarterly report of the ATA-140 project South Sulawesi.

3). CIDA (Canada)'s Document.

4). German's Document ; East Kalimantan Transmigration Area Development Project.

5). German's Document ; Record of Discussions.

6). Evaluation of the Agricultural Development Project in West - Sumatera (ADS / ADP) and of the Regional Planning in West Pasaman (German).

7). ASEAN Consultative Meeting of Experts on Community Development.

8). Policies and Analysis to Support Decision Made in the Indonesia Agricultural Sector.

9). The Proposed Paddy Fields Multi-Croping Syatem of Sugar cane Field.

10). Food Crops.

11). Evaluation of the Development of the Fisheries in South Sulawesi during 1969 - 1975 and Projected Planning until 1978.

12). Prospect of Various Estate Crop Commodities in South Sulawesi from 1977 - 1990.

13). Irrigation Development in South Sulawesi.

14). General Report of Carry-out the South Sulawesi Animal Husbandry during the PELITA i and PELITA II.

(16) Subject and Drill Book for the Regional Planning (A Planning Guideline for the Regional Agricultural Development) June 1979, JICA.

(17) Report for Evaluation Survey Team on the RADP/ ATA-140 South Sulawesi Project. June 1979.

I-4-2 Indonesian Publications during Phase I and Phase II

(1). Proyek Perencanaan Pembangunan Pertanian Regional ATA-140 Sulawesi Selatan, Laporan Final Tahap Pertama, Ringkasan dan Rekomondasi dari Jilid I, II dan IV.

(Pebruari 1979, Team Proyek RADP/ ATA-140 Sulawesi Selatan di U.Pandang).

(2). Proyek Perencanaan Pembangunan Pertanian Regional ATA-140 Sulawesi Selatan, Laporan Final Phase ke II Jilid II Laporan Feasibility Study tentang peningkatan dalam penghijauan, padang perumputan, pengembangan jeruk dan pertambakan pada Kabupaten-kabupaten tertentu.

(Mei 1979, Team Pryek RADP / ATA-140 Sulawesi Selatan di Ujung Pandang).

(3). Proyek Perencanaan Pembangunan Pertanian Regional ATA-140 Sulawesi Selatan, Laporan Final Tahap kadua Jilid III, Rencana Pembangunan Pertanian Kabupaten Jeneponto.

(Juni 1979, Team Proyek RADP / ATA-140 Sulawesi Selatan di Ujung Pandang).

(4). Proyek Perencanaan Pembangunan Pertanian Regional ATA-140 Sulawesi-Selatan, Laporan Final Tahap Kedua Jilid IV, Rencana Pembangunan Pertanian Kabupaten Enrekang.

(Juni 1979, Team Proyek RADP / ATA-140 Sulawesi-Selatan di Ujung Pandang).

(5). Tanggapan mengenai Pembangunan Pertanian di Indonesia oleh Advisor Proyek : Yoshihisa MIKI.

(Team Proyek RADP / ATA-140 Sulawesi Selatan di Ujung Pandang, Juni 1979).

(6). Hasil Seminar III, Rencana Pembangunan Pertanian Regional ATA-140 Sulawesi Selatan, tanggal 12 - 13 Maret 1979 di Ujung Pandang.

I-4-3 English Publications during Phase III (June, 1979 - June, 1982).

(1). Report of the Survey for Implementation and Designing of the Pilot Tests.

(Oct, 1979, JICA, ADT JR 79-35).

(2). South Sulawesi Regional Agricultural Development Planning ATA-140 Project, Annual Progress Report Phase III, June 1979 - July 1981.

(July, 1980, the RADP / ATA-140 South Sulawesi Project Team in U. Pandang).

(3). South Sulawesi Regional Agricultural Development Planning ATA-140 Project, Annual Progress Report Phase III, July, 1980 - June, 1981.

(June, 1981 the RADP / ATA-140 South Sulawesi Project Team in U. Pandang).

(4). The Final Report of Phase III, the RADP / ATA-140 South Sulawesi Project.

(The RADP / ATA-140 South Sulawesi Project Team in Ujung Pandang).

* The Final Report includes the economic and financial justification of the model projects in the three fields of Citrus, Grassland and Afforestation which correspond to the feasibility study mentioned in R/D, and also includes the operational plan of three Pilot Test in future.

(5). An Aspect of Citrus Pests in South Sulawesi, Indonesia February, 1982, by : Yasusuke SAKAGAMI, Entomologist, JICA short-term expert.

(JICA, JR 82-4).

(6). The Survey Report of Citrus Diseases in South Sulawesi, Indonesia March, 1982, by : Dr. Hiroyuki IEKI, JICA short-term expert, Fruit Tree Research Station, MAFF, Japan

(March, 1982, the RADP / ATA-140 South Sulawesi Project Team in Ujung Pandang).

(7). Forestry Survey Report of DAS Saddang area in South Sulawesi, water Conservation and Vegetation, by : Hiroei CHIKAARASHI, short-term expert on Forest Hydrology, and by : Osamu TANDO, short-term expert on Forest Ecology

(The RADP / ATA-140 South Sulawesi Project Team in Ujung Pandang).

(8). The Survey Report of Animal Husbandry in South Sulawesi, Characteristics of Bali cattle and Grazing Management, by : Dr. T. MATSUKAWA, and by Osamu SUZUKI, short-term expert on livestock.

(The RADP / ATA-140 South Sulawesi Project Team in Ujung Pandang).

(9). The First Citrus Contest in South Sulawesi performed by : The RADP/ ATA-140 South Sulawesi Project Team at Desa Tino, Kabupaten Jeneponto from August 25 to 28, 1980

(December, 1980, the RADP / ATA-140 South Sulawesi Project Team in Ujung Pandang).

(10) Tentative Conclusion and Discussion Matters of the Seminar on Regional Agricultural Development Planning in Jakarta on January 22 - 24, 1981

(March 1981, the RADP / ATA-140 South Sulawesi Project Team in Ujung Pandang).

(11) The First Quarterly Report on Phase III from July to September 1979.

(October 1979, the RADP / ATA-140 South Sulawesi Project Team in Ujung Pandang).

(12) The Second Quarterly Report on Phase III from October to December 1979.

(December 1979, the RADP / ATA-140 South Sulawesi Project Team in Ujung Pandang).

(13) The third Quarterly Report on Phase III from January to March 1980.

(March 1980, the RADP / ATA-140 South Sulawesi Project Team in Ujung Pandang).

(14) The Fifth and Sixth Quarterly Report on Phase III from August 1980 to December 1980.

(January 1981, the RADP / ATA-140 South Sulawesi Project Team in Ujung Pandang).

* The Fourth Quarterly Report (April 1980 - June 1980) was included in Annual Progress Report Phase III, July 1980.

* Annual Progress Report on Phase III of final one year (July 1981 - June-1982) was included in the Final Report of Phase III, June 1982.

I-4-4 Indonesian Publications during Phase III

(1). Laporan Studi Perencanaan Pengembangan Pertanian Blok III, Kabupaten Bone, Soppeng dan Wajo.

(Team Studi Perencanaan Pengembangan Pertanian Blok III, 1981).

(2). Laporan Analisa Tanah Areal Grassland Improvement ATA-140 pada ketinggian 1.000 meter diatas permukaan laut didesa Buntu Barana, Kecamatan AILA, Kabupaten Enrekang Propinsi Sulawesi Selatan.

(April 1981, Proyek RADP / ATA-140 Sulawesi Selatan di Ujung Pandang).

(3). Laporan Inventarisasi Jeruk Lokal pada 7 Kabupaten di Propinsi Sulawesi Selatan, Tana Toraja, Soppeng, Wajo, Bulukumba, Selayar, Bantaeng, dan Majene, oleh : Ir. Muh. Arifin Lamba.

(31 Maret 1981, RADP / ATA-140, Proyek Sulawesi Selatan Ujung Pandang).

(4). Survey Penyakit Jeruk di Sulawesi Selatan, oleh : Dr. Hiroyuki IEKI, Tenaga Akhli jangka pendek dari JICA.

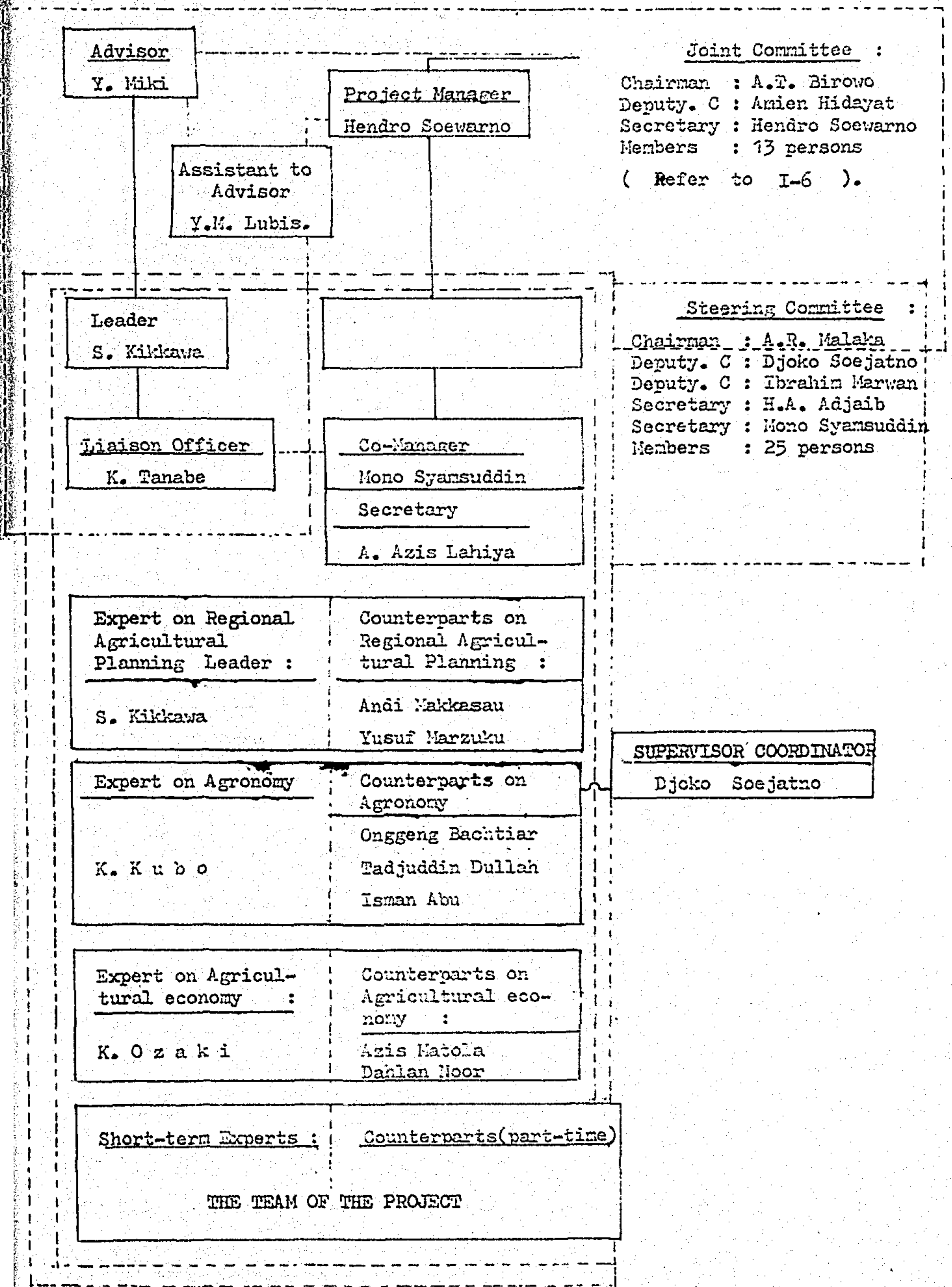
(Juni 1982, Team Proyek RADP / ATA-140 Sulawesi Selatan di Ujung Pandang).

(5). Suatu Aspek Tentang Hama Citrus di Sulawesi Selatan, laporan akhir survey oleh : Yasusuke SAKAGAMI.

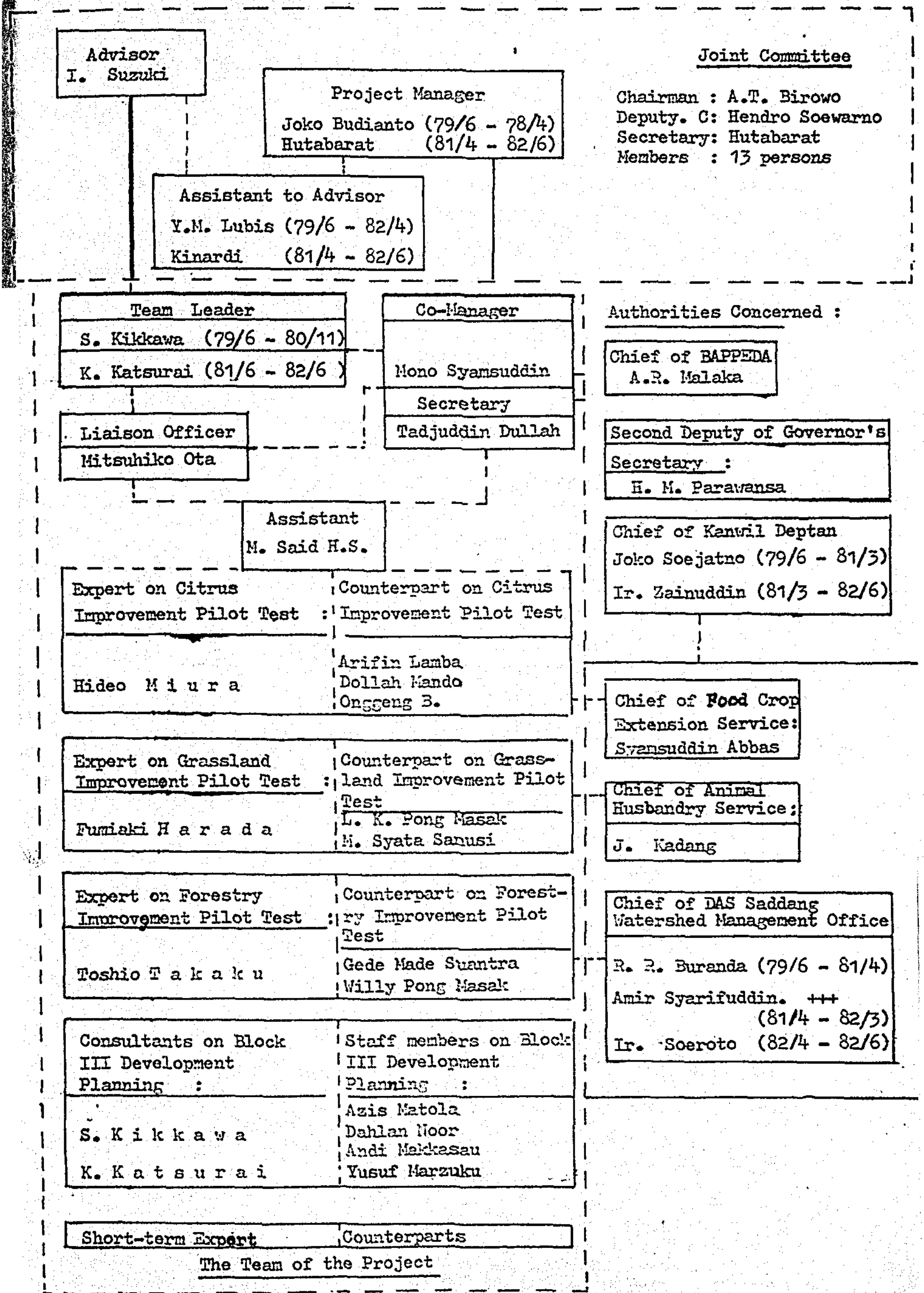
(6). Pedoman Perencanaan untuk Pembangunan Pertanian Wilayah, Buku Petunjuk Praktis Bagi Perencana -Perencana Wilayah, oleh : JICA.

I-5 The Project Team's Structure of Organization

I-5-1 Phase I and Phase II (Dec. 1976 - June 1979)



I-5-2 Phase III (June 1979 - June 1982)



I-6 Composition of the Joint-Committee

Chairman : 1. Director of the Bureau of Planning Ministry of Agriculture (M.A.) / Dr. Ir. A.T. Birowo

Deputy chairman : 2. Chief of the Project Evaluation and Analysis Division, M.A.

Secretary : 3. Staff of the Bureau of Planning, M.A.

Members (1) Indonesian Members :

4. Director of Programming of Directorate General of Food Crop, M.A.
5. Director of Programming of Directorate General of Animal Husbandry, M.A.
6. Director of Programming of Directorate General of Forestry, M.A.
7. Director of Programming of Directorate General of Fishery, M.A.
8. Director of Programming of Directorate General of Estate Crops, M.A.
9. Chief of the Bureau of Agriculture and Irrigation of BAPPENAS.
10. Chief of the Bureau of Regional II of BAPPENAS.
11. Staff of the Agency of Agricultural Education, Training and Counselling, M.A.
12. Chief of the BAPPEDA of South Sulawesi Province.

Members (2) Japanese Members :

13. Advisor.
14. Team Leader.
15. Liaison Officer.
16. Head of JICA Office in Jakarta.
17. Experts designated by the Team Leader.

N o t e : The Embassy's staff and the persons nominated by the Embassy of Japan may attend the meeting of the Committee as observers.

Remark : (1). This list is based on the Record of Discussions for the Project on RADP/ ATA-140 of South Sulawesi.

(2). Structure of the Joint Committee has not been changed since Phase I and Phase II to Phase III.

I-7 Members of the Project Team

I-7-1 Phase I and Phase II (Dec. - June 1979)

(1) Japanese Experts

Yoshihisa Miki	Advisor of the Project	(Jakarta)
Setsuzo Kikkawa	Team Leader	(U.Pandang)
Kiyoaki Kubo	Agronomist	"
Kunihiro Ozaki	Agricultural Economist	"
Koji Tanabe	Liaison Officer of Expert's Team	"
(Short-term Experts)		
Iwao Nishiyama	Marketing / Processing 1977,10-12 / 2 months	
Ryuichi Tatsumi	Water resources 1977,10-12 / 2 months	
Yoshihiko Ogawa	Regional Agri. Planning 1977, 12 / 1 month	
Takeichiro Kafuku	Fishery resources 1977, 12-1978, 1 / 2 months	
Masaaki Funada	Soil and Vegitation 1977, 12-78, 1 / 2 months	
Hiroyuki Nishimura	Socio-economic condition and Farmer's needs 1977, 12 - 1978, 1 / 2 months	
Hiroshi Murai	Forestation 1978, 1 - 2 / 1 month	
Kanae Morinishi	Organization for Agri. Development 1978, 2-3 / 1 month	
Nobuharu Sasano	Regional Agri. Planning 1978, 10-11 / 2 weeks	
Tetsuro Miyazato	Water resources 1978, 5- 1979, 3 / 11 months	
Hiroshi Matsuo	Regional Agri. Planning 1978,11 / 3 weeks	

(2) Indonesian Counterparts and the project staff members

Hendro Soewarno	Manager of the Project	(Jakarta)
Y.M. Lubis	Secretary of the Project Manager	"
Mono Syamsuddin	Co-Manager of the Project	(U.Pandang)
A. Azis Lahiya	Secretary to the Project Co-Manager	"
Azis Mattola	Economist	"
Andi Makkasau	Regional Planner	"
Nazaruddin L.	Agri. Economist (Until August 1978)	"
Dahlan Noor	Economist	"
Onggeng Bachtiar	Agronomist	"
Tadjuddin Dollah	Aquaculturist	"
Yusuf Marzuku	Agronomist	"
Isman Abu	Agronomist	"
(Part-time counterpart)		
Zainuddin Dahlan	Water resources	"
Siregar	Agrarian / Mapping	"
Kaharuddin Salihi	Forestation	"

Muctar Palentai	Organization for Agricultural Development	(U.Pandang
J. Sampe	Animal Husbandry	"
Fauziah	Animal Husbandry	"
Titien Mangga Bara	Forestation Mapping	"
Loeky Yasin Rakhman	Translator	"
Muh. Said	Assistant of Accounting Section	"
Syahrullah Naim	Assistant "	"
Fien Latuihamallo	Typist	"
Seniwati	"	"
Siti Aisyah	"	"
Amiruddin	Driver of the Project	"
Achmad	"	"
Daude	"	"
Johny Lawalata	"	"
Lukas	"	"
Daeng Ralla	"	"
Sangkala	"	"
Sangkala M.	"	"
Rahim	Office boy	"
Hafid	"	"

(3) Short-term Consultants

Terushi Egashira	Lecturer of Seminar I	1977,8 / 2 weeks
Shingo Ito	Leader of Consultation Team from JICA	1977,6-7/2 weeks
Shozo Ogasawara	Member of the Team	1977,6-7/2 weeks
Mitsuhiko Ota	"	1977,6-7/2 weeks
Koichi Baba	Leader of Technical Guidance Team, JICA	1978,2-3/2 weeks
Hiroyoshi Tanabe	Member of the Team	1978,2-3/2 weeks
Mitsuhiko Ota	"	1978,2-3/2 weeks
Kazuo Muto	Lecturer of Seminar II	1978,4 /12 days
Isao Suzuki	Leader of Technical Guidance Team, JICA	1978,7-8/12 days
Shigeyoshi Nishiwaki	Member of the Team	1978,7-8/12 days
Katsuhiko Akiyama	"	1978,7-8/12 days

(4) Participants of Training in Japan

A.T. Birowo	Observation	1976,	1 / weeks.
A.R. Malaka	"	1977,	2 / weeks.
Hendro Soewarno	"	1977,	2 /weeks.
Amien Hidayat	"	1978,	3 / weeks.
Djoko Soejatno	"	1978,	3 / weeks.
Muhammad Ishak Iskandar	"	1978,	10 / days.
Abdullah Dollar	"	1978,	10 / days.
Mono Syamsuddin	Regional Planning	1978,	1 / month.
Onggeng Bachtiar	"	1978,	1 / month.
Y.M. Lubis	"	1978,	1 / month.
Nazaruddin L.	"	1978,	1 / month.
Tadjuddin Dullah	"	1978,	1 / month.
Amiruddin Madjid	"	1978,	1 / month.
Dahlan Noor	Agri. Statistics	1978,	3 / months.
Azis Nattola	Economic Development and Regional Planning	1977 - 1978	6/months.

I-7-2 Phase III (June 1979 - June 1982)

(1). Japanese Experts

Isao Suzuki	Advisor of the Project (Jakarta).
Setsuzo Kikkawa	Team Leader (79/6 - 80/11).
Isao Suzuki	Acting Leader (80/12 - 81/6).
Koichiro Katsurai	Team Leader (81/6 - 82/6).
Hideo Miura	Expert on Citrus Imp. Pilot Test.
Fumiaki Harada	" Grassland Imp. Pilot Test.
Toshio Takaku	" Forestry Imp. Pilot Test.
Mitsuhiko Ota	Liaison Officer of the Project.
(Short-term Expert)	: Duration
Kenji Sekio	Civil Engineer, 1980, 3 - 12 / 9 months.
T. Matsukawa	Expert on Livestock, 1980, 4 - 5 / 1 month.
K. Kondo	Regional Planner 1980, 4 - 5 / 1 month.
K. Watanabe	Forestry Mechanics, 1980, 9 - 1981, 11 / 2 months
Yasusuke Sakagami	Entomologist, 1980, 12 - 1981, 2 / 2 months.
Kazuo Muto	Regional Planner (Seminar) 1981, 2 / 10 days.
Nobuharu Sasano	" " " " " " "
Hidetoshi Takama	Agr. Economist, 1981, 2 - 1981, 3 / 3 weeks.
H. Chikaarashi	Forestry Hydrology, 1981, 5 - 6 / 1.5 months.
Osamu Suzuki	Grazing Management, 1981, 10 - 12 / 2 months.
Osamu Tando	Forestry Ecology , 1981, 11 - 12 / 1 month.
Hiroyuki Ieki	Citrus Pest Control, 1982, 1 - 3 / 2 months.
Hidetoshi Takama	Agr. Economist , 1982, 2 - 3 / 3 weeks.

(2). Indonesian Counterparts and the Project's staff members

A.P. Hutabarat	Manager of the Project	(Jakarta).
Kinardi	Secretary of the Project Manager	"
Mitien	Typist	"
Mono Syamsuddin	Co-Manager of the Project	(U.Pandang)
Hasan Habibie	Chief of Accounting Section	"
Tadjuddin Dullah	Secretary of the Project's Co-Manager	"
Onggeng Bachtiar	Counterpart for Citrus Imp. Pilot Test	"
Arifin Lamba	" " "	"
Dollah Mando	" " "	"

Amiruddin	Farm Manager	(U.Pandang).
L.K. Pong Masak	Counterpart of Grassland Imp. Pilot Test	"
M. Syata Sanusi	" " "	"
I Gede Made Suantra	" Forestry Imp. Pilot Test	"
Willy Pong Masak	" " "	"
Azis Mattola	Staff members of Block III Dev. Planning	"
Dahlan Noor	" " "	"
Andi Makkasau	" " "	"
Yusuf Marzuku	" " "	"
Muh. Said	Secretary of Accounting Section	"
Syahrullah Naim	Assistant for Mechanical Maintenance	"
Natsir Sulaiman	" "	"
Rachmawaty H.S.	" Accounting Section	"
Loeky Yasin Rakhman	Translator	"
Siti Aisyah	Typist	"
Suharni	"	"
Intan Djatmiko	"	"
Marhumi Pattau	"	"
Diana D Allus	"	"
Amiruddin	Driver	"
Pa'bo	"	"
Rauf	"	"
Malik Djaya	"	"
Sinyo	"	"
Sangkala	"	"
Saibo	"	"
Luther	"	"
Zainuddin	Office boy	"
Chaming	"	"
Rahim	"	"

(3) Short-term Consultants

Shoji Kamatsu	Leader of the Implementation Survey Team	1979, 7 - 8/15 days.
Hiroyoshi Ihara	Member of the Team	1979, 7 - 8/25 days.
Takanobu Furukoshi	" "	1979, 7 - 8/25 days.
Shigeru Ono	" "	1979, 7 - 8/25 days.
Tomanosuke Shichijo	" "	1979, 7 - 8/25 days.

Asao Yamada	Member of the Team	1979, 7 - 8/25 days.
Toshio Takaku	" "	1979, 7 - 8/25 days.
Y. Matoba	Technical Guidance for Model Infra. Construction	1980, 2 / 3 days.
T. Isoyama	" "	1980, 2 / 3 days.
Moriya Miyamoto	Observation to the Pilot Test Site	1980, 3 / 5 days.
Tomochika Uchida	" "	1980, 4 / 4 days.
Shoji Kanatsu	Leader of the Technical Guidance Team	1980, 6 - 7/17 days.
Toranosuke Shichijo	Member of the Team	1980, 6 - 7/17 days.
Shigeru Ono	" "	1980, 6 - 7/17 days.
Takanobu Furukoshi	" "	1980, 6 - 7/17 days.
Asao Yamada	" "	1980, 6 - 7/17 days.
Hidetoshi Takama	" "	1980, 6 - 7/17 days.
Moria Miyamoto	Observation to the Pilot Test Site	1980, 7 - 8 / 5 days.
T. Imai	JICA follow-up Team for Model Infra. Works	1980, 9 -10/12 days.
M. Sugawara	Member of the Team	1980, 9 -10/12 days.
M. Ishii	" "	1980, 9 -10/12 days.
Ken Uesugi	Leader of the Technical Guidance Team	1981, 6 / 13 days.
Isao Iwagaki	Member of the Team	1981, 6 / 13 days.
Koichi Nakashima	" "	1981, 6 / 13 days.
Takanobu Furukoshi	" "	1981, 6 / 13 days.
Shunichi Tateishi	" "	1981, 6 / 13 days.

(4) Participants of Training in Japan

Yusuf Marruku	Regional Planning	1980,2 - 1980,5 3 months.
Arifin Lamba	Citrus Improvement	1980,5 - 1980,10 6 months.
Djoko Budianto	Observation	1980,7 - 1980,8 2 weeks.
Andi Suradi	"	1980,7 - 1980,8 2 weeks.
I Gede Made Suantra	Forestry Improvement	1980,8 - 1981,2 6 months.
L. Kalla Pong Masak	Grassland Improvement	1980,8 - 1981,2 6 months.
A.T. Birowo	Observation	1981,4 10 days.
Willy Pong Masak	Forestry Improvement	1981,8 - 1982,2 6 months.
M. Syata Samusi	Grassland Improvement	1981,8 - 1982,2 6 months.
Dollah Mando	Citrus Improvement	1981,9 - 1982,3 6 months.
H.M. Purawansa	Observation	1982,6 2 weeks.

CHAPTER II. Regional Agricultural Development in Indonesia.

Isao Suzuki.

Contents

CHAPTER II. REGIONAL AGRICULTURAL DEVELOPMENT IN INDONESIA

II-1. Introduction :

Indonesia has achieved a rapid progress in agricultural development through implementation of the Five Year Development Plans (I, II and III) in each of which top priority has been given to the promotion of this sector.

From the viewpoint of national economy, Indonesian agriculture has to bear the role of providing the people with sufficient foodstuff, supplying the materials to domestic industries and earning foreign exchange through export of its products. These make agriculture one of the most important sectors of national economy.

Indonesia is, however, a vast country consisting of 27 provinces, each of which is quite different in its economic and agricultural conditions and has a characteristic feature in agricultural structure such as land use, cropping system, farming way and so on.

Therefore, the policy for developing agriculture to meet national needs mentioned above should be simultaneously based on the complicated reality of agriculture in respective province and naturally not be uniform throughout the country but be differentiated according to regional conditions. Any development plan formulated without taking due consideration to the regional conditions would not be successful. As such, it must always be kept in mind that every development project is to be implemented in the area where the specific agro-climatic conditions exist and by the farmers who live in a specific socio-economic structure.

The economic development always accompanies new problems. In the course of accelaration of agricultural development, the neccesity of keeping a balance among the regions and realizing a harmony among the sub-sectors has become more acute.

There was a big gap in their development stage among the provinces before launching the Five Year Development Plan. This existing gap must not be widened but narrowed through the implementation of development activities.

Similarly, the development of each sub-sector should not hamper an integrated development of the region but contribute to a harmonious development which assure an everlasting utilization of regional resources.

This is the very reason why regional agricultural development planning has risen in importance in Indonesia recently.

The agricultural development plan can be realized effectively and smoothly only when it reflects fully the needs of the region and the people in conformity with national requirement.

At the time of preparation of the IV-th Five Year Plan, it would be useful to study the course of regional agricultural development during the past years. In this study, three provinces East Java, South Sulawesi and South-East Sulawesi have been taken up as a sample of the advanced, the medium developed and the backward province respectively.

Some information such as gross income, land use, development plan, development budget and realization have been collected and analized.

<u>Note : Data Source</u>

1. Statistik Indonesia
   Biro Pusat Statistik Jakarta.
2. Penyebaran Proyek Pelita 1981 / 1982
   Biro Perencanaan Deptan.
3. Direktorat Jenderal Pertanian Tanaman Pangan.
4. Direktorat Jenderal Kehutanan
5. Direktorat Jenderal Perikanan
6. Direktorat Jenderal Peternakan
7. Direktorat Jenderal Perkebunan
8. Biro Pusat Statistik Jakarta : National Income
   Gross Domestic Product.

II-2. Economic Structure :

II-2-1. Land Area.

Table 1. Land Area

	Area	%
Whole Indonesia	1,919,443 km2	100.0
East Java	47,922	2.5
South Sulawesi	72,781	3.8
South-East Sulawesi	27,686	1.4

East Java, South Sulawesi and South-East Sulawesi occupy respectively 2.5%, 3.8 % and 1.4 % of the whole Indonesia in area and they are not much different from each other.

II-2-2. Population.

Table 2. Population

(Thousand)

	1976	1977	1978	1979	1980
Whole Indonesia	131,304	133,940	136,630	139,326	142,178
East Java	27,466	27,858	28,277	28,703	29,135
South Sulawesi	5,716	5,838	5,973	6,105	6,261
South-East Sulawesi	789	805	821	836	852

The population of East Java, South Sulawesi and South-East Sulawesi in 1978 occupy respectively 21.5 %, 4.3 % and 0.6 % of the whole Indonesian population, density in 1978 is 584. 80 and 30 persons / km^2 respectively, showing much difference among the provinces from the most densely populated East Java to the most sparsely populated South-East Sulawesi.

II-2-3. Labor Force.

Table 3. Labor Force in 1977

	1977	% to total population
Whole Indonesia	48,314 (thousand)	36
East Java	11,462	41
South Sulawesi	1,727	30
South-East Sulawesi	327	41

The low percentage of labor force to total population in South Sulawesi is distinct, although its reason is not clear. Is it due to a social movement of a great many labor force into other provinces seeking better opportunity of employment.

Table 4. Classification of Labor Force in 1977

(thousand)

	Farmers (%)	Sales & Service (%)	Production Transportation (%)	Others (%)	Total (%)
Whole Indonesia	29,586 (61)	9,147 (19)	6,938 (14)	2,643 (5)	48,314 (100)
East Java	7,501 (65)	2,229 (19)	1,267 (11)	465 (4)	11,462 (100)
South Sulawesi	1,005 (58)	252 (15)	348 (20)	122 (7)	1,727 (100)
South-East Sul.	258 (79)	25 (8)	27 (8)	16 (5)	327 (100)

The proportion of respective class in East Java is almost simillar to the national average.

The low percentage of farmers is characteristic to South Sulawesi against the high percentage of farmers in South-East Sulawesi. This shows that the low percentage of labor force in South Sulawesi mentioned before might be attributed mainly to the low percentage of farm labor force.

It seems that because the active character of the people, competition for employment opportunity between the agricultural sector in South Sulawesi and the jobs in other provinces brought about the specific labor structure there.

II-2-4. Gross Domestic Product.

Table 5. Gross Domestic Product in 1977

(Rp. Billion)

	Agriculture (%)	Industry (%)	Service (%)	Total (%)
Whole Indonesia	5,905 (31)	6,545 (34)	6,560 (35)	19,010 (100)
East Java	1,100 (40)	501 (18)	1,126 (41)	2,727 (100)
South Sulawesi	298 (53)	44 (8)	217 (39)	559 (100)
South-East Sul.	25 (51)	12 (25)	10 (21)	47 (100)

It is needless to say that there is a marked difference in the economic scale among three provinces with an approximate ratio of 50:10:1 for East Java, South Sulawesi and South-East Sulawesi.

The agricultural sector occupies 31%, 40%, 53% and 51% for all Indonesia, East Java, South Sulawesi and South-East Sulawesi respectively.

This shows the weight of agriculture is fairly higher in these three provinces especially in both provinces of Sulawesi comparing with the national average.

II-2-5. Per Capita Income.

Table 6. Per Capita Income in 1977

	Gross Domestic Product		Population		Per Capita Income
Whole Indonesia	Rp.19,010 Billion	/	133,940 thousand	=	141,929 Rupiah .
East Java	Rp. 2,727	/	27,857	=	97,892
South Sulawesi	Rp. 559	/	5,838	=	95,752
South-East Sul.	Rp. 47	/	805	=	58,385

The per capita income in the three provinces is obviously lower than the national average, probably because of comparably little income from the sector of industry especially from oil in these provinces.
The specially low per capita income of South-East Sulawesi shows undoubtedly the backwardness of its economy.

II-2-6. Labor Productivity.

Table 7. Productivity of Sectors in 1977

	Agricultural Income (Rp.Billion)	Farm Labor (thousand)		Other Income (Rp.Billion)	Other Labor Force (thousand)	
Whole Indonesia	5,905 /	29,586 =	200 (thousand Rp.)	13,105 /	18,728 =	700
East Java	1,100 /	7,501 =	147	1,627 /	3,961 =	411
South Sulawesi	298 /	1,005 =	297	261 /	722 =	361
South-East Sul.	25 /	258 =	97	22 /	69 =	319

It must be notable that the productivity of the agricultural sector is much different by the province, from the highest of Rp.297 thousand in South Sulawesi to the lowest of Rp.97 thousand in South-East Sulawesi in contrast with other sectors where not much difference is observed.
This indicates the existence of a big gap in agricultural development among the provinces which must be overcome in the future.

In addition, the relatively high productivity of agriculture in South Sulawesi is characteristic, comparing with East Java and South-East Sulawesi where the figure of agriculture is almost one-third of other sectors.

II-3. Agricultural Structure :

II-3-1. Land Use.

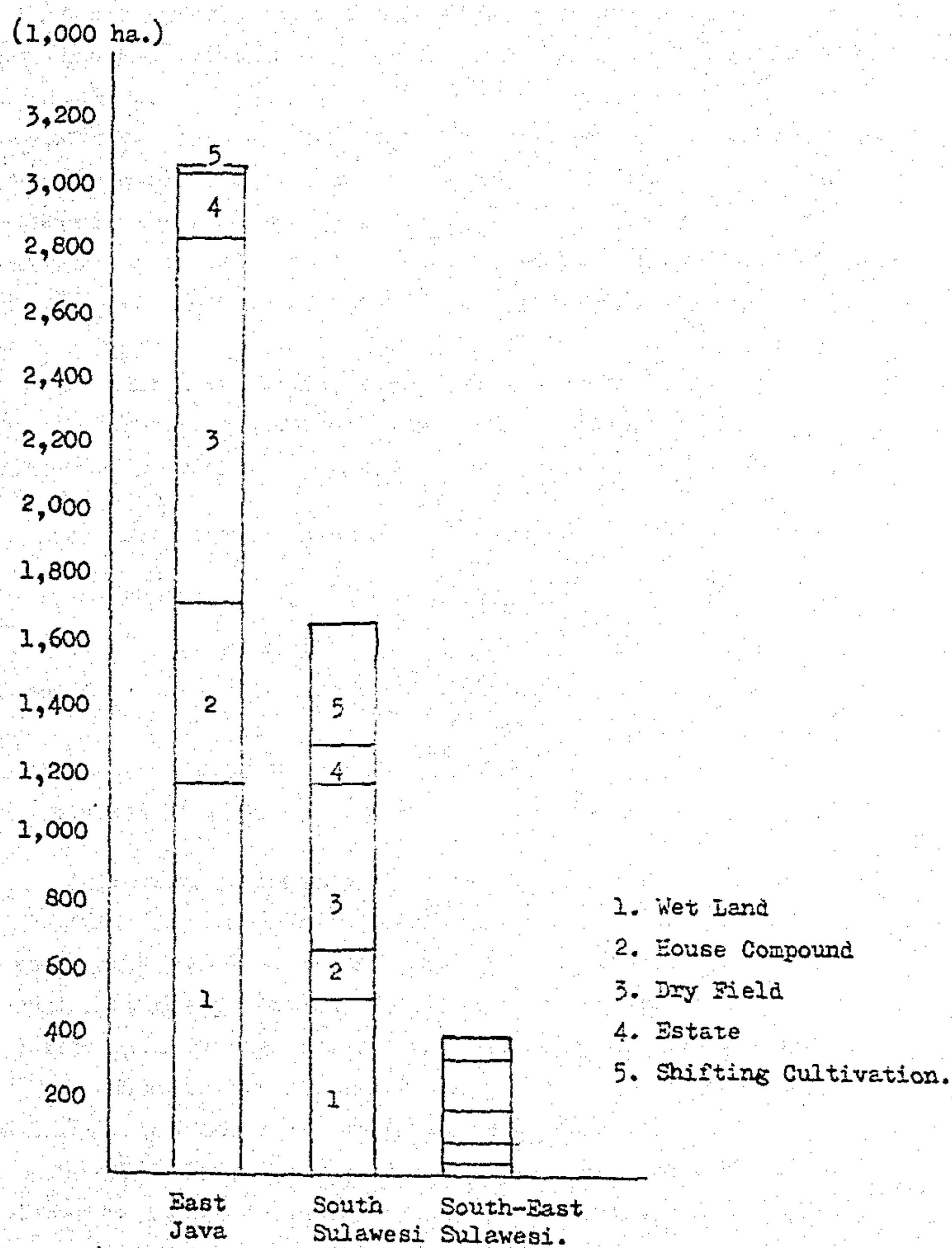
Table 8. Land Use in 1978

(thousand ha).

		Whole Indonesia		East Java		South Sul.		South-East Sul.	
Wet Land	(1)	6,718	(26) %	1,205	(39) %	543	(32) %	25	(6) %
House Compound	(2)	4,672	(18)	561	(18)	147	(9)	68	(16)
Dry Field	(3)	6,802	(26)	1,123	(36)	499	(30)	108	(25)
Estate	(4)	5,457	(21)	176	(6)	130	(8)	144	(34)
Shifting Cultivation.	(5)	2,456	(9)	15	(0)	366	(22)	81	(19)
Total (cultivated Land).	(6)	26,105	(100)	3,080	(100)	1,685	(100)	425	(100)
% of (6) to Total Land Area.		14 %		64		23		15	
Grassland	(7)	2,810		11		333		326	
Temporary Fallow.	(8)	5,628		6		867		341	
Total((7)+(8))=(9)		8,438		17		1,200		667	
% of (9) to Total Land Area.		4		0		16		24	
Forest	(10)	122,227		1,314		3,222		1,716	
% of (10) Total Land Area.		63		27		44		61	

GRAPH - 1.

Classification of Cultivated Land



The percentage of cultivated land to total land area is 64. 23 and 15 % for East Java, South Sulawesi and South-East Sulawesi respectively, showing the intensity of land use in each province in succession.
The low percentage of wet land in South-East Sulawesi and the high percentage of shifting cultivation in both South Sulawesi and South-East Sulawesi are typical.

On the contrary, the percentage of grassland and temporary fallow land in both province of Sulawesi is particularly high, indicating the extensive land use there.
From these indexes, it is apparent that land-use pattern is the most intensive, moderate and the most extensive in East Java, South Sulawesi and South-East Sulawesi respectively.
It means on the other hand that the potential for future development of land-use in East Java is limited and that in both provinces of Sulawesi is still great.

It is most essential to clarify the causes of extensive land-use and to consider the appropriate measure for realizing the more intensive use of land in these two provinces.

II-3-2. Labor Intensity on Agricultural Land.

Table 9. Labor Intensity in 1977

	Farm Labor	/ Cultivated Land	Intensity
Whole Indonesia	29,586 thousand	/ 26,105 thousand ha	= 1.1 persons / ha.
East Java	7,501	/ 3,080	= 1.4
South Sulawesi	1,005	/ 1,685	= 0.6
South-East Sulawesi	258	/ 425	= 0.6

It is naturally understood from the land use pattern that the labor intensity in East Java is quite higher than that in both provinces of Sulawesi. However, the same level of intensity of 0.6 in South and South-East Sulawesi does not seem convincing, judging from the fact that the intensity of land use in South Sulawesi is fairly higher than that in South-East Sulawesi.

This might be attributed to the different pattern of labor force distribution in both provinces as mentioned in II-2-3.
In other words it would be said that farmers in South-East Sulawesi are not fully utilized by the agricultural sector but left under low employment.
This suggests the necessity of preparing better agricultural conditions in South-East Sulawesi so that farm labor force there can become more active and more productive.

II-3-3. Farm Gross Income

Table 10. Farm Gross Income in 1977

(Billion Rp)

	Whole Indonesia	East Java	South Sul.	South-East Sul.
Food Crops	3,659 (61%)	787 (71)	179 (62)	17 (68)
Other Crops	1,088 (18)	192 (17)	16 (5)	2 (8)
Livestock	305 (5)	86 (8)	36 (12)	3 (12)
Forestry	524 (9)	11 (1)	1 (0)	1 (4)
Fishery	328 (6)	24 (2)	59 (20)	2 (8)
T o t a l	5,905	1,100	291	25

The big share occupied by food crops is common to all provinces. Characteristics is the high percentage of other crops in East Java and of Livestock and fishery in both provinces of Sulawesi.

II-3-4. Land Productivity.

Table 11. Land Productivity in 1977

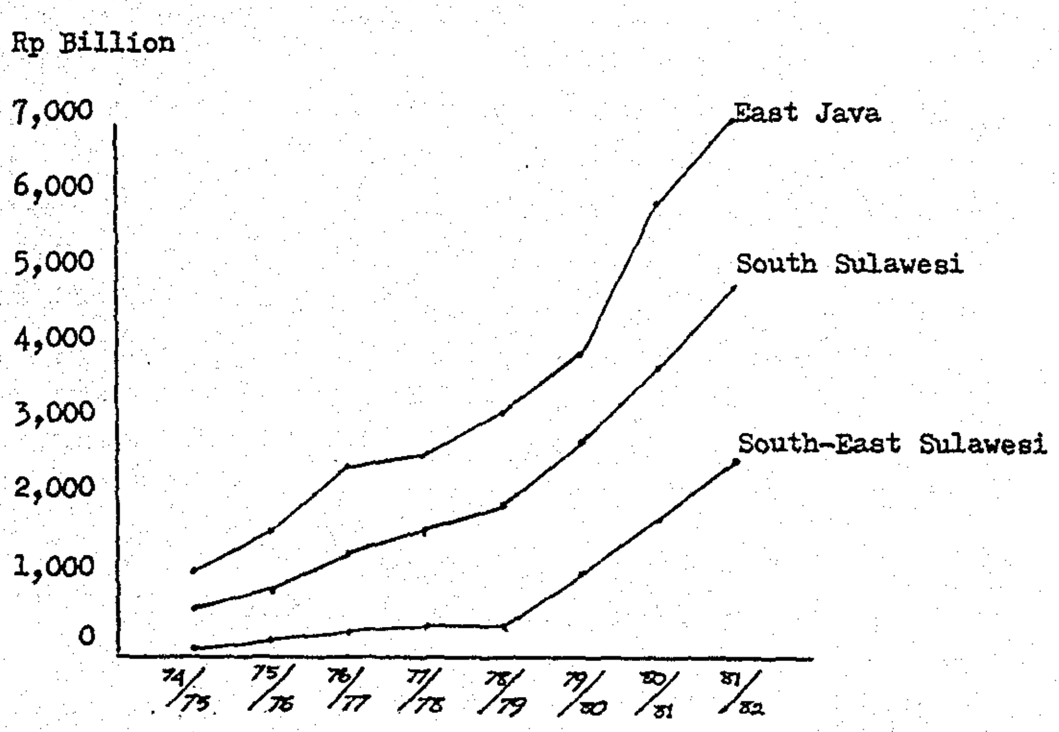
	Product from Crops		Cultivated Land	Productivity
Whole Indonesia	4,747 Billion Rp	/	26,105 thousand ha	= 182 thousand Rp/ha.
East Java	979	/	3,080	= 318
South Sulawesi	195	/	1,685	= 116
South-East Sulawesi	19	/	425	= 44

The difference in land productivity among the provinces is surprisingly great. It is assumed that the most important factor affecting the productivity in South Sulawesi might be the existence of a large area of shifting cultivation and estate with low productivity.
Anyhow, this fact shows the inferior agricultural conditions in both provinces of Sulawesi comparing with East Java.
In order to increase farmers' income under these unfavorable circumstances, conversion of land-use from the extensive one to the intensive one is indispensable.

On the other hand, the measure for promoting the other sub-sectors such as livestock, forestry and fishery which do not depend directly on cultivated land should be extensively taken up.

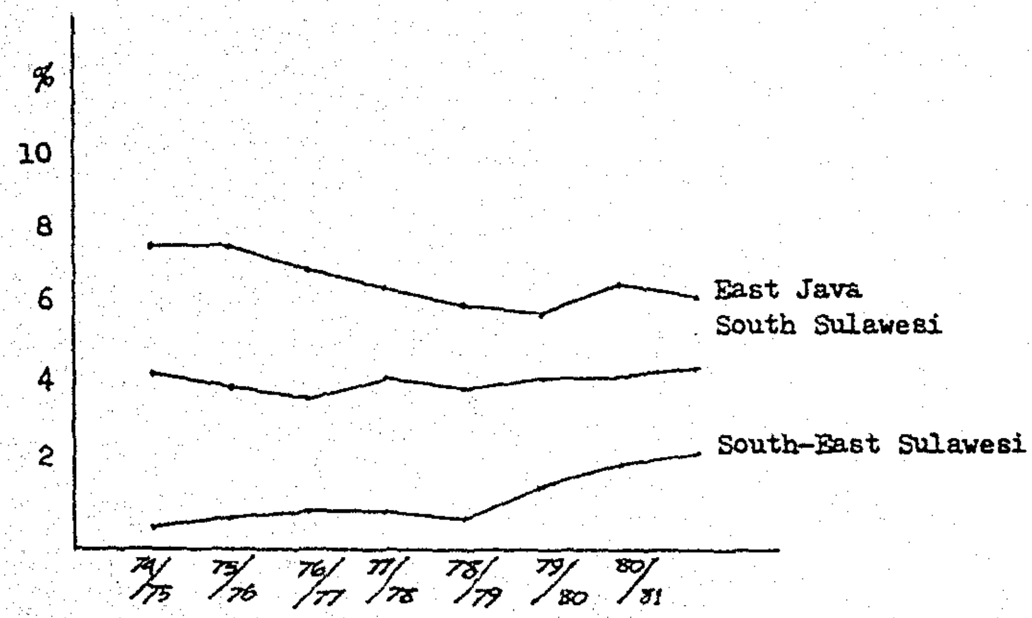
GRAPH - 2.

Development Budget



GRAPH - 3.

% of Respective Province
to the entire Indonesia.



II-4. Development Effort.

The efforts for developing agriculture is financed through the Central Government Development expenditure and other non-budgetary source such as capital investment.

The latter also has been greatly contributing to the development especially in the sector of forestry and commercial crops. In this study, however information on the former only are collected due to a difficult availability of data concerning the latter.

The development budget is allocated to the Secretariate General, 5 Directorate Generals and 2 Agencies according to the administrative structure. Because Secretariate General and 2 agencies are not directly concerned with the implementation of projects in the province, the budget for only 5 Directorate Generals is analized in this study.

II-4-1. Total Budget for PELITA II and III.

Table 12. Budget for PELITA II (from 1974/75 - 1978/79)

(million Rp).

	Whole Indonesia	East Java	South Sulawesi	South-East Sulawesi
Food	35,206 (22.8)	1,950 (17.3)	1,750 (26.2)	450 (32.3)
Bimas	27.610 (17.9)	5,028 (44.7)	1,612 (24.1)	146 (10.5)
Estate	31,214 (20.2)	730 (6.5)	768 (11.5)	297 (21.3)
Animal Husbandry	13,258 (8.6)	954 (8.5)	865 (13.0)	105 (7.5)
Fishery	23,075 (15.0)	1,732 (15.4)	530 (7.9)	168 (12.1)
Forestry	23,879 (15.5)	847 (7.5)	1,151 (17.2)	228 (16.4)
Total	154,242 (100%)	11,241 (7.3%)	6,676 (4.3%)	1,394 (0.9%)

Table 13. Budget for PELITA III (from 1979/80 - 1980/81)

(million Rp).

	Whole Indonesia	East Java	South Sulawesi	South-East Sulawesi
Food	92,002 (36.0)	3,723 (21.7)	2,990 (25.6)	2,772 (50.0)
Bimas	38,085 (15.0)	5,325 (31.1)	2,178 (18.7)	467 (8.4)
Estate	32,776 (12.8)	2,469 (14.4)	1,112 (9.5)	763 (13.7)
Animal Husbandry	30,669 (12.0)	2,533 (14.8)	1,393 (11.9)	878 (15.8)
Fishery	29,649 (11.4)	1,891 (11.0)	1,146 (9.8)	305 (5.5)
Forestry	32,449 (12.7)	1,186 (6.9)	2,856 (24.5)	367 (6.6)
Total	255,630 (100%)	17,127 (6.7%)	11,675 (4.6%)	5,552 (2.2%)
III/II	1.7 times	1.5 times	1.7 times	4.0 times.

II-4-2. Budget Allocation to Province.

Budget allocation to East Java, South Sulawesi and South-East Sulawesi account for 7.3, 4.3 and 0,9 % of the national budget in PELITA II and 6.7, 4.6 and 2.2 % in PELITA III respectively.
This shows the gradual shifting of priority from the advanced province to the backward province in allocating the national budget.
As a result, total amount of budget for South-East Sulawesi showed a remarkable increase at a ratio of 4.0 times in contrast to 1.5 and 1.9 times for East Java and South Sulawesi between the Period of PELITA II and III.
This seems to be a very important policy change from PELITA II to PELITA III from the viewpoint of regional development.

The above trend seems to be justified in view of the role of the government which is to lead the development activity by supporting farmer's self-efforts.
Particularly in Indonesia where there is a big gap in the developmental stage of agriculture among the provinces and where the developmental resources are limited, the backward provinces like South-East Sulawesi should be given first priority to improve the infrastructure which is the base for future development.
On the other hand, the advanced provinces like East Java are expected to continue their spontaneous development based on the comparably well established conditions.

Table 14. Budget per Farm Labor

	Whole Indonesia	East Java	South Sul.	South-East Sul.
Total Budget for (million) Agriculture in PELITA II (A)	154,242	11,241	6,676	1,394
Total Budget for (million) Agriculture in PELITA III (B)	255,630	17,127	11,675	5,552
Farm Labor (C) (thousand) in 1977	29,586	7,501	1,005	258
A/C (Rp/person)	5,213	1,499	6,643	5,403
B/C (Rp/person)	8,640	2,283	11,617	21,519

Calculation of the budget per farm labor shows that the index for East Java is far lower than that for both provinces of Sulawesi. This is justified because of the small size of farming in East Java comparing with other provinces.
The index for South-East Sulawesi in PELITA II which was lower than that for South Sulawesi is not convincable from the viewpoint of poor condition in the former. It is much appreciated that this unfavorable position of South-East Sulawesi was clearly placed up in PELITA III absorbing twice the budget for South Sulawesi.

Table 15. Budget per Cultivated Land

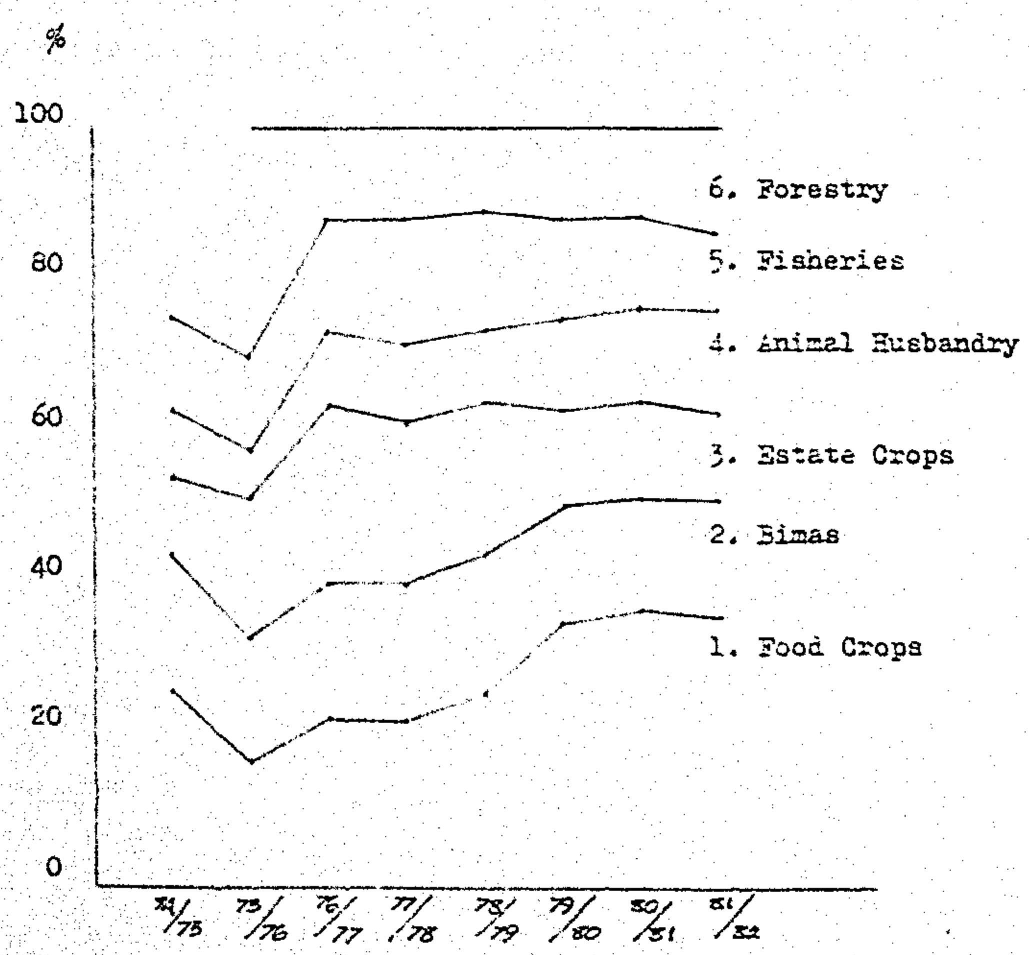
		Whole Indonesia	East Java	South Sul.	S.E. Sul.
Budget for Crop Sector (million) in PELITA II (A)		94,030	7,708	4,130	893
Budget for Crop Sector (million) in PELITA III (B)		162,863	11,517	6,280	4,002
Cultivated Land (C)	(thousand ha)	26,105	3,080	1,685	425
A/C	(Rp/ha)	3,602	2,503	2,451	2,101
B/C	(Rp/ha)	6,239	3,739	3,727	9,416

By similar calculation of the budget for crop sector per cultivated land, it is observed that all indexes are not much different by the province with respective PELITA except that for South-East Sulawesi in PELITA III. It is not clear why the allocation to South Sulawesi is still left at the same level as East Java, in spite of the fact the land condition in the former is far inferior to the latter.

II-4-3. Budget Allocation to Sub-Sectors.

(1). National Budget.

Graph 4. % of Respective Sub-Sector in National Budget



For 1974/75 and 1975/76, the sector of forestry received a relatively high percentage of allocation accounting for nearly 30 % and was reduced suddenly from 1976/77 to around 10 %. This was due to a financial shift of a part of program for forestry from the Ministry of agriculture to the other ministry according to the Presidential Decree.

After that, budget for food crops including Bimas has been steadly increasing from 40 % in 1976/77 to 50 % in 1981/82 in contrast to the gradual decrease of budget for estate crops and fishery.
This might show the Government policy in recent years to give high priority on the promotion of food crop production including the transmigration program and to encourage more capital investment for the development of estate crops and fishery.

The share of the respective sector, however, is of course much varied by province, as seen later.

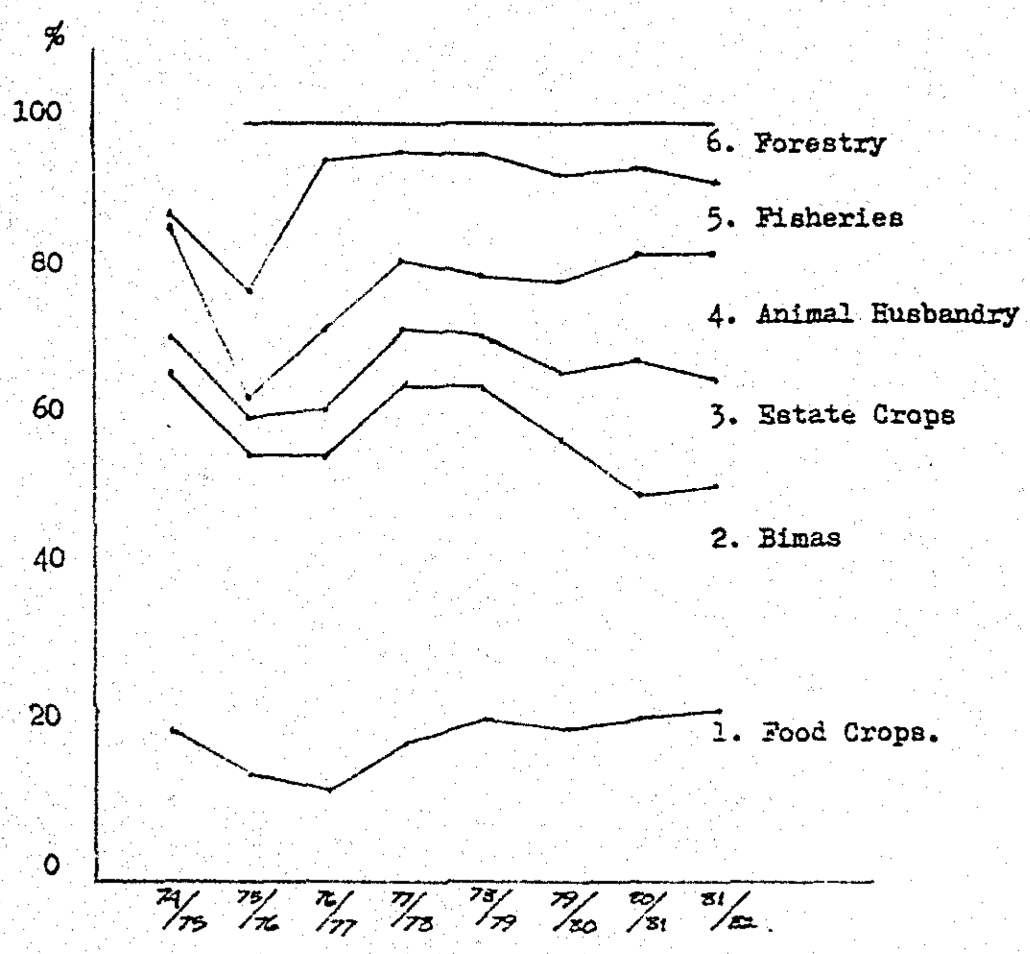
(2). Budget for the Province.

As mentioned with national budget, a series of figures concerning the share of respective sector does not keep continuity throughout the period from 1974/75 to 1981/82, because the financing system of the forestry sector was revised in 1976/77.

Then the analysis on the share of respective sector covers the period after 1976/77.

1). East Java.

Graph 5. % of Respective Sub-Sector in Provincial Budget of East Java.

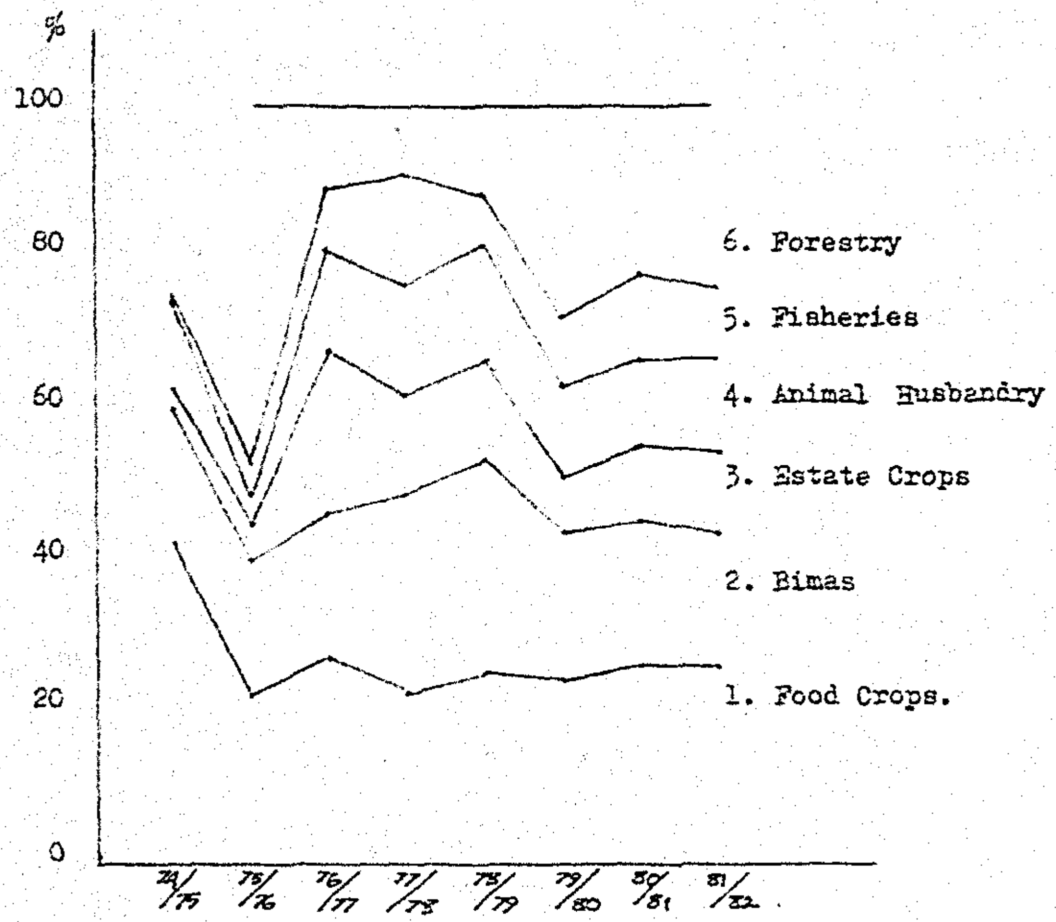


The sector of Food Crops including Bimas occupies around 45 % in 1981/82 with gradual decline after reaching the peak of 65 % in 1977/78 and 1978/79. The decrease of Bimas is remarkable from 47 % in 1977 to 29 % in 1981/82. Is this due to the fact that Bimas Program in East Java has succeeded in covering a large part of the area comparably earlier than the other provinces? The sector of fishery also showed a distinct decrease from 22 % in 1976/77 to 8 % in 1981/82.

On the contrary, the sectors of Animal Husbandry and Estate Crops have recorded a rapid increase of their share in PELITA III.

2). South Sulawesi

Graph 6. % of Respective Sub-Sectors in Provincial Budget of South Sulawesi.



The share of the forestry sector has jumped up from around 5 % in PELITA II to more than 20 % in PELITA III.

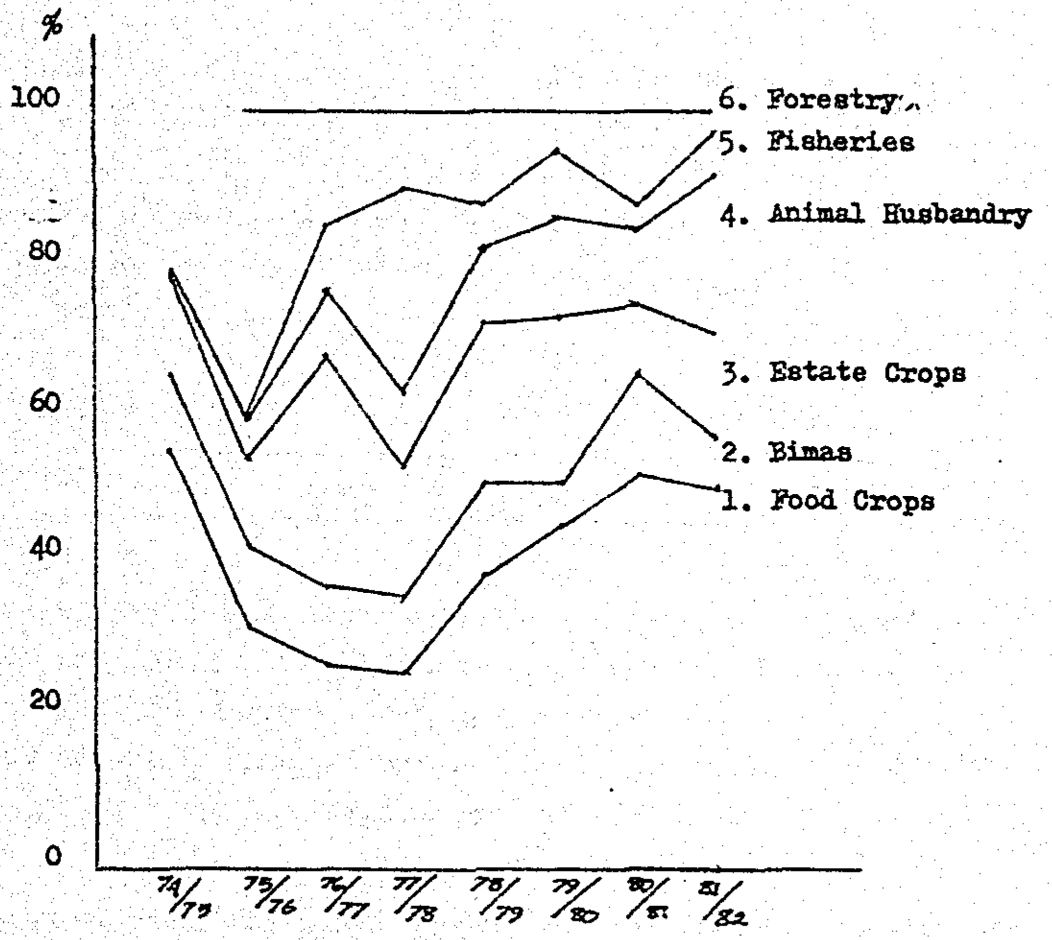
This shows the important policy change in PELITA III giving the first priority on the development of forestry in view of the serious land conditions of the province. The other sector besides forestry increased at a rate which is almost the same as that in East Java.

It means that the expansion of national development expenditure favorable to South Sulawesi comparing with East Java has been realized mainly owing to the big increase of the forestry sector.

Much change in the share of the other sectors besides forestry is not observed keeping the nearly same level of relative share throughout the period of PELITA II and III.

3). South-East Sulawesi

Graph 7. % of Respective Sub-Sectors in Provincial Budget of South-East Sulawesi.



Together with the more rapid expansion of the allocation to this province as compared with other provinces as mentioned in II.-4-1, a great annual fluctuation can be noticed in the share occupied by the respective sector.
It seems to indicate that the policy for developing each sector is not concretely positioned in comprehensive development plan of the province.

The sector of food crops, however, has shown a sharp expansion from the bottom of 35 % in 1977/78 to around 60 % in 1980/81 and 1981/82 which accounts for nearly 10 times in actual term.
Next to food crops, the sector of animal husbandry has also expanded its share with the big growth rate. Although the sector of Estate Crops recorded the decrease in its relative share to the total budget, the growth rate in actual term is still keeping a moderate level. The allocation to both sectors of fishery and forestry seems to be stagnating.

II-5. Realization of Development :

II-5-1. Food Crops.

Table 16. Area Harvested for Food Crops in 1980

(thousand ha).

	Whole Indonesia	East Java	South Sul.	South-East Sul.
Paddy (Wet land)	7,807 (53%)	1,370 (34%)	579 (54%)	11 (10%)
Paddy (Dry land)	1,210 (8)	60 (1)	28 (3)	19 (17)
Maize	2,770 (19)	1,085 (27)	350 (32)	48 (42)
Cassava	1,413 (10)	996 (25)	31 (3)	25 (22)
Sweet Potatoes	286 (2)	40 (1)	11 (1)	6 (5)
Peanut	507 (3)	140 (3)	47 (4)	2 (2)
Soy Bean	726 (5)	371 (9)	18 (2)	2 (2)
T o t a l	14,719 (100)	4,062 (100)	1,064 (100)	113 (100)

(1). Wet Paddy :

South Sulawesi and East Java have shown a steady increase in harvested area and yield. On the other hand the production in South-East Sulawesi has been stagnant throughout the period.
Attention should be directed to the fact that much difference in the level of yield is still remaining among three provinces.

(2). Maize :

In East Java, yield has increased year by year although there is still much annual fluctuation in harvested area.
In both provinces of Sulawesi, a rapid increase in harvested area is observed although yield remains at low level.

(3). Peanut :

In South Sulawesi only, much development through the increase in harvested area has been relized.

(4). Soy Beans :

A seizable development has been realized through the increase of yield in East Java and that of harvested area in South Sulawesi.

(5). Dry Paddy, Cassava, Sweet Potatoes :

Remarkable development cannot be recognized with an unstable annual fluctuation in harvested area and yield.

Summarizing the production trend of food crops during the period, it can be said that intensification for increasing yield in East Java and extensification for increasing harvested area in South-East Sulawesi have played an important role for the overall development of production.

South Sulawesi seems to be situated at a transitional position where both or either one of extensification and intensification are going on depending on the kind of crop and the location grown.

Table 17. FOOD CROPS

Province	1974	1975	1976	1977	1978	1979	1980
			1. PADDY (Wet)				
Area (000 ha)							
East Java	1,262	1,262	1,277	1,255	1,309	1,338	1,370
South Sulawesi	425	499	455	514	579	554	579
South-East Sulawesi	15	11	9	11	14	14	11
Whole Indonesia	7,340	7,334	7,229	7,202	7,698	7,663	7,807
Yield (ton/ha)							
East Java	32.72	31.88	34.17	35.02	36.59	39.58	45.07
South Sulawesi	23.37	23.87	27.93	29.54	29.14	29.68	30.94
South-East Sul.	18.36	15.48	18.60	17.57	17.72	18.05	20.70
Whole Indonesia	28.68	28.43	30.72	30.28	31.40	32.39	35.91
			2. PADDY (Dry)				
Area (000 ha)							
East Java	60	65	61	57	61	59	60
South Sulawesi	20	19	19	23	30	32	28
South-East Sulawesi	14	16	18	16	24	19	19
Whole Indonesia	1,168	1,160	1,139	1,157	1,230	1,186	1,210
Yield (ton/ha)							
East Java	13.55	13.21	12.79	12.98	13.27	14.72	16.47
South Sulawesi	11.00	11.98	12.73	12.14	11.71	12.90	13.20
South-East Sul.	12.36	10.87	11.08	11.46	10.17	9.81	12.61
Whole Indonesia	12.08	12.76	12.72	13.30	12.99	12.91	14.32
			3. MAIZE				
Area (000 ha)							
East Java	1,225	1,086	859	1,098	1,224	1,097	1,085
South Sulawesi	150	150	159	258	284	235	350
South-East Sulawesi	23	38	34	50	51	41	48
Whole Indonesia	2,666	2,444	2,095	2,566	3,024	2,593	2,770

Province	1974	1975	1976	1977	1978	1979	1980
<u>Yield</u> (ton/ha)							
East Java	10.45	11.86	12.76	12.99	13.43	14.83	15.60
South Sulawesi	11.34	9.80	11.89	10.30	12.56	12.39	13.04
South-East Sulawesi	12.58	12.97	11.81	11.69	11.26	11.75	12.64
Whole Indonesia	11.28	11.87	12.28	12.24	13.32	13.90	14.48
		4. <u>CASSAVA</u>					
<u>A r e a</u> (000 ha)							
East Java	495	456	434	416	431	455	496
South Sulawesi	38	35	31	37	38	36	31
South-East Sulawesi	19	16	20	20	23	24	25
Whole Indonesia	1,509	1,410	1,353	1,363	1,382	1,439	1,413
<u>Yield</u> (ton/ha)							
East Java	79	86	87	86	91	92	92
South Sulawesi	83	90	95	97	85	90	94
South-East Sulawesi	95	98	97	65	67	76	78
Whole Indonesia	86	89	90	92	93	96	96
		5. <u>SWEET POTATOES</u>					
<u>A r e a</u> (000 ha)							
East Java	55	62	51	55	45	42	40
South Sulawesi	10	8	9	13	12	9	11
South-East Sulawesi	4	4	6	5	6	5	6
Whole Indonesia	330	310	301	326	300	286	286
<u>Yield</u> (ton/ha)							
East Java	75	80	79	73	63	69	75
South Sulawesi	65	70	60	75	68	72	76
South-East Sulawesi	83	82	64	64	59	60	65
Whole Indonesia	75	78	79	75	69	76	77
		6. <u>PEANUT</u>					
<u>A r e a</u> (000 ha)							
East Java	141	159	126	143	135	136	140
South Sulawesi	21	32	23	51	44	36	47
South-East Sulawesi	1	1	1	1	1	1	2
Whole Indonesia	410	474	414	507	506	473	507

Province	1974	1975	1976	1977	1978	1979	1980
Yield (ton/ha)							
East Java	7.51	7.91	7.94	7.88	8.51	8.98	9.62
South Sulawesi	6.51	7.50	8.71	8.27	8.12	9.92	10.62
South-East Sulawesi	8.51	7.70	7.17	7.29	5.85	6.57	7.54
Whole Indonesia	7.48	9.00	8.23	8.06	8.54	8.97	9.38

7. SOYA BEANS

Area (000 ha)							
East Java	373	393	341	333	349	373	371
South Sulawesi	8	7	9	11	14	21	18
South-East Sulawesi	0	1	1	1	1	2	2
Whole Indonesia	768	751	646	646	733	784	726
Yield (ton/ha)							
East Java	7.67	8.04	8.44	8.25	7.81	9.66	9.99
South Sulawesi	6.87	6.66	6.66	6.88	7.01	6.41	6.94
South-East Sulawesi	6.64	4.58	6.27	5.83	5.76	5.80	6.05
Whole Indonesia	7.67	7.85	8.07	8.09	7.70	8.67	8.85

II-5-2. Assessment of Food Production in the Three Provinces

Table 18. Cropping Intensity of Food Crops

		Whole Indonesia thousand ha.	East Java	South Sul.	South-East Sul.
Harvested area of food crops	A	14,719	4,062 "	1,064 "	113 "
Cultivated land (wet land, House Compound, Dry Field and shifting Cultivation).	B	20,648	2,904 "	1,555 "	281 "
Intensity	A/B	0.7	1.4	0.7	0.4

The intensity of 1.4, 0.7 and 0.4 indicates clearly the difference of land productivity for food crops in respective provinces.
The high intensity in East Java might be attributed mainly to the intensive cultivation through double or triple cropping.
On the other hand, the low intensity in South-East Sulawesi does not neccesarily show the big share covered by non food crops, but the existence of a large area of cultivated land which is not fully utilized for production.

Table 19. Harvested Area of Food Crops per Capita

		Whole Indonesia thousand ha	East Java	South Sul.	South-East Sul.
Harvested area	A	14,719	4,062	1,064	113
Population in 1980	B	142,178	29,135	6,261	852
Area per Capita	A/B	0.10	0.14	0.17	0.13

Comparing with national average, area per capita in the three proprovinces quite high. Accordingly, both East Java and South Sulawesi have a lot of surplus of food crops especially of rice which greatly contributes to stable supply of food stuff for the nation.
Particularly, taking account of the intensity of food production in South Sulawesi which is still fairly lower than that in East Java, the potential of future development in South Sulawesi is assumed to be great.

However, South-East Sulawesi remains at a barely subsistence level because of its low productivity in spite of that area per capita there is almost the same as East Java.

II-5-3. Non Food Crops by Small Holder

Table 20. Area Planted for Non-Food Crop in 1979

	Whole Indonesia	Esat Java	South Sulawesi	South-East Sul.
Rubber	1,969 (32%)	-	0 (0%)	-
Coconut	2,516 (41%)	222 (37%)	107 (58%)	34 (81%)
Coffee	582 (10%)	35 (6%)	27 (14%)	4 (10%)
Clove	340 (6%)	25 (4%)	13 (7%)	1 (2%)
T e a	39 (1%)	0	-	-
Sugar cane	201 (3%)	148 (25%)	1 (0%)	0
C a p o k	312 (5%)	122 (20%)	27 (14%)	2 (5%)
Tobacco	139 (2%)	44 (7%)	11 (6%)	0
C o c o a	10 (0%)	0	1 (0%)	1 (2%)
T o t a l	6,108 (100%)	596 (100%)	187 (100%)	42 (100%)

Coconut :
The area planted for coconut ranks at the first and has steadly increased commonly in the three provinces. The share of coconut in South-East Sulawesi is specifically high.

Coffee :
The steady development has been achieved throughout the period in all three provinces.

Clove :
The production of clove has been showing a rapid development with a remarkable growth rate through the period in three provinces.

Sugar cane :
Sugar cane is a crop characteristic to East Java which occupies around 70 % of Indonesian total area and ranks at the second next to coconut in area there. The area, however, is not always stable with a substantial annual fluctuation.

Kapok :
Kapok is also one of the important non-food crops in East Java and South Sulawesi with a moderate increase.

Table 21. Non-Food Crops by Small Holder

Province	1974	1975	1976	1977	1978	1979
			1. RUBBER			
Area (000 ha)						
East Java	-	-	-	-	-	-
South Sulawesi	0	0	0	0	0	0
South-East Sulawesi	-	-	-	-	-	-
Whole Indonesia	1,872	1,868	1,862	1,864	1,870	1,969
			2. COCONUT			
Area (000 ha)						
East Java	169	171	170	202	230	222
South Sulawesi	92	97	100	103	106	108
South-East Sulawesi	29	30	31	32	33	34
Whole Indonesia	2,109	2,196	2,229	2,393	2,454	2,517
			3. COFFEE			
Area (000 ha)						
East Java	26	29	27	27	31	36
South Sulawesi	25	25	25	26	26	27
South-East Sulawesi	3	3	3	4	4	4
Whole Indonesia	347	359	394	454	477	582
			4. CLOVE			
Area (000 ha)						
East Java	11	17	15	13	18	25
South Sulawesi	3	7	8	9	12	14
South-East Sulawesi	0.3	0.4	0.4	0.6	1	1
Whole Indonesia	172	216	232	284	301	340
			5. SUGAR CANE			
Area (000 ha)						
East Java	54	68	61	75	49	148
South Sulawesi	1	1	1	0.5	1	1
South-East Sulawesi	0.3	0.3	0.3	0.3	0.3	0.2
Whole Indonesia	72	87	91	118	102	201

Province	1974	1975	1976	1977	1978	1979
			6. KAPOK			
Area (000 ha)						
East Java	106	109	108	122	123	123
South Sulawesi	20	24	25	25	27	28
South-East Sulawesi	2	2	3	3	3	3
Whole Indonesia	299	311	323	294	302	312
			7. TOBACCO			
Area (000 ha)						
East Java	58	57	57	61	57	44
South Sulawesi	12	10	14	12	4	11
South-East Sulawesi	0	0	0	0.2	0.3	0.3
Whole Indonesia	127	139	148	138	125	139

II-5-4. Summary of Crop Production

Rough calculation of several index shows the typical structure of crop production in respective province as follows.

Table 22. Index of Crop Production

		East Java	South Sul.	South-East Sul.
Cultivated Land/Farm Labor	(A) ha	0.4	1.6	1.1
Cropping Intensity	(B)	1.6	0.8	0.6
Cropping Area/Farm Labor	(C) ha	0.6	1.3	0.6
Profitability of crop	(D)	1	0.9	0.8
Productivity of land	(E)	1	0.8	0.6
Income from crop/Farm Labor (C x D x E).	(F)	0.6	0.9	0.3

Note :

B. Figure obtained by dividing total cropping area (Food Crops + Non Food Crops) by total cultivated land.

D. Figure showing the assumed relative value of aggregated profitability of crops.

E. Figure showing the relative value of avarage yield of crops.

In spite of that cultivated land in South Sulawesi and South-East Sulawesi is quite big accounting for four times and three times that in East Java respectively, income from crops per farm labor is not parallel to the size of area. The biggest factor determining income is cropping intensity which is much different by province from 1.6 in East Java to 0.6 in South-East Sulawesi. As a result, cropping area in South Sulawesi is nearly twice that in East Java and that in South-East Sulawesi is almost the same as East Java.

The next factor is commerscial value of crops grown in each province. It is obvious from the cropping pattern that crops grown in South-East Sulawesi are less profitable compared with those in other provinces. The third factor is land productivity, namely yield of crops, which are clearly shown in statistic from the highest in East Java to the lowest in South-Esat Sulawesi.

Eventually, the relative index of income from crops per farm labor is roughly estimated at 2,3 and 1 with East Java, South Sulawesi, South-East Sulawesi respectively.

In order to overcome the existing constraints for increasing farmers income, several countermeasures such as improvement of land conditions, efficient use of labor force, improvement of marketing infrastructure and technological development should be taken up in integrated way according to the needs of each province.

II-5-5. Animal Husbandry.

Table 23. Livestock Population in 1979

(thousand heads).

	Whole Indonesia	East Java	South Sul.	South-East Sulawesi
Dairy	92	23	0	-
Cattle	6,395	2,570	786	32
Buffalo	2,315	228	458	9
G o a t	8,047	1,711	455	41
Sheep	3,680	598	24	0
P i g	2,961	63	342	2
Horse	625	58	211	-

(1). D a i r y :

The rearing of dairy in Indonesia is still in its infancy and the population is concentrated only in the area near big consuming cities. Therefore, dairy breeding is seen in East Java only with a steady growth rate.

(2). C a t t l e :

Cattle is most popular in three provinces and high growth rate of population in South Sulawesi and South-East Sulawesi is striking against the stagnation in East Java.

(3). Buffalo, Goat, Sheep :

Not much change is observed in their population in East Java and South East Sulawesi in contrast to a constant development in South Sulawesi.

(4). P i g :

East Java and South Sulawesi is showing a smooth increase of the population. It seems to be generally said that East Java is now almost saturated with a large number of livestock in relation to its limited land area except dairy and pigs which do not depend much on grass for their feed.

On the contrary, South Sulawesi and South-East Sulawesi have still a great potential for future development by full utilization of a vast area of grass land.

Particularly, cattle production in Sulawesi will raise its importance from the viewpoint of national economy when a steady increase of demand for beef is forecasted.

Table 24. Livestock Population

(thousand heads)

Province	1974	1975	1976	1977	1978	1979
1. DAIRY						
Whole Indonesia	86	90	87	91	93	92
East Java	10	17	16	18	21	23
South Sulawesi	-	0.1	0.1	0.1	0.1	0
South-East Sulawesi	-	-	-	-	-	-
2. CATTLE						
Whole Indonesia	6,380	6,242	6,237	6,217	6,330	6,395
East Java	2,426	2,352	2,426	2,569	2,573	2,570
South Sulawesi	429	485	536	602	661	786
South-East Sulawesi	15	17	21	24	26	32
3. BUFFALO						
Whole Indonesia	2,415	2,432	2,284	2,292	2,312	2,315
East Java	218	213	242	233	232	228
South Sulawesi	361	375	381	419	451	458
South-East Sulawesi	12	14	15	7	8	9
4. GOAT						
Whole Indonesia	6,517	6,315	6,904	7,232	8,051	8,047
East Java	1,728	1,929	1,742	1,744	1,747	1,711
South Sulawesi	232	288	347	390	425	455
South-East Sulawesi	56	59	67	41	34	41
5. SHEEP						
Whole Indonesia	3,403	3,374	3,603	3,864	3,611	3,680
East Java	530	530	518	567	575	598
South Sulawesi	7	9	12	14	15	24
South-East Sulawesi	0	0	0	0	0	0
6. PIG						
Whole Indonesia	2,906	2,707	2,947	2,979	2,902	2,961
East Java	47	41	52	48	52	63
South Sulawesi	244	334	418	511	572	342
South-East Sulawesi	-	-	-	1	1	2

II-5-6. Fisheries.

Table 25. Fisheries Product

(thousand ton)

Province	1974	1975	1976	1977	1978	1979	1980
			MARINE				
Whole Indonesia	948	996	1,081	1,157	1,227	1,317	1,397
East Java	50	90	126	138	135	132	140
South Sulawesi	108	112	114	119	126	159	156
South-East Sulawesi	15	15	18	19	22	20	31
			INLAND				
Whole Indonesia	388	394	401	214	420	431	488
East Java	33	47	36	38	35	45	52
South Sulawesi	33	34	35	38	45	43	53
South-East Sulawesi	-	-	1	2	1	2	2
			TOTAL				
Whole Indonesia	1,336	1,390	1,482	1,371	1,647	1,748	1,885
East Java	83	137	162	176	170	177	192
South Sulawesi	141	146	149	157	171	204	209
South-East Sulawesi	15	15	19	21	23	22	33

In 1980, total production in East Java and South Sulawesi is almost the same, amounting to nearly two hundred thousand tons and that in South-East Sulawesi is very low, accounting for about 15 % of the former two provinces. The share of marine products in total production is also equal in both East Java and South Sulawesi with a percentage of 75 %.

The brackish water culture in South Sulawesi is especially well developed occupying about 30 % of inland fisheries.

In general, the development during the period was successful except inland fisheries in South-East Sulawesi.

II-5-7. Forestry.

Table 26. Wood Production

(thousand m^3)

Province	1972	1973	1974	1975	1976	1977	1978	1979	1980
Whole Indonesia	17,717	26,297	21,753	16,296	21,428	22,939	26,256	24,618	21,702
East Java	358	372	321	236	371	440	304	-	309
South Sulawesi	114	148	188	100	98	151	148	127	66
South-East Sulawesi	18	51	45	41	-	8	10	34	-

Table 27. Area of Critical Land in 1979

(thousand ha)

Province	In Forestry	Outside Forestry	Total
Whole Indonesia	3,403	5,797	9,200
East Java	-	132	132
South Sulawesi	240	448	688
South-East Sulawesi	686	126	812

In these provinces, wood production is at present not so important from the viewpoint of national and provincial economy, because the production forest is limited in area or located in a remote area which makes the wood production economically difficult.

On the other hand, existence of a large area of critical land is the biggest constraint for future development of not only agriculture but also all economy in the region. Therefore, more attention is being paid to the promotion of reforestation and afforestation for the purpose of water and soil conservation and increase of forest production.

Table 28. Realization of Afforestation

('000 ha).

Province	Pelita I	Pelita II	Pelita III	Total Pelita (I+II+III)
Whole Indonesia	430	1,645	404	2,479
East Java	76	274	83	434
South Sulawesi	27	192	33	253
South-East Sulawesi	-	23	18	41

Particularly afforestation has a close relation with land use such as shifting cultivation and grassland for animal, managed by the farmers living in critical lands. Then the location of afforestation and the species of trees planted is carefully selected, taking into consideration the improvement of their farming structure.

II-6. Evaluation of Budget Allocation and Development Realization.

It is needless to mention that investment through developmental budget is not always expected to produce a quick return in a short period. It would be, however, meaningful for working out future development policy to review the relation between budget allocation and realization of development in the past PELITA.

II-6-1. East Java :

In spite of relative decline of budget for food crops, production of paddy, maize and soy bean showed a steady development. This seems to indicate that food production in the province now stands at a well established infrastructure and has a capability to continue its expansion mainly through the efforts of farmers.

Under these circumstances, the role of the government should be clarified in relation to the spontaneous activities by farmers and be directed more to the improvement of marketing facilities and technological development.

Generally summarizing, production of noon-food crops by small-holder and animal husbandry are not showing a smooth development in proportion to the big increase of budget.

Detailed study would be necessary on the effectiveness of the projects implemented in the past to formulate a long term policy.

II-6-2. South Sulawesi :

Although it seems to be too early to assess the investment on forestry which usually takes a long time to obtain the return, a careful study should be made on the achievement of reforestation and afforestation in the past to promote more effective implementation of the projects in the future in view of the great investment put into this sector.

Food crop production showed a steady development especially in paddy production similar to East Java. But a special attention should be paid to the dual structure of food crop production in the province consisting of rather developed wet paddy and backward upland food crops to realize a balanced development of both fields in the future.

Although animal husbandry has shown a smooth development in proportion to the budget allocation, this sector can be given a higher priority together with forestry in view of the large area of grassland found in critical areas and of an important supply source of cattle for national animal husbandry.

II-6-3. South-East Sulawesi :

Generally speaking, no outstanding development has been recorded comparing with the favorable allocation of budget in recent years except selective fields, being left far behind other provinces.

This might be an unavoidable fact under the poor basic conditions of overall economy and agriculture in this province.

It will take some time obtain a real return from the recently increased investment.

It is, however, a time to establish a long term policy for development of respective sector in the whole structure of agriculture.
Considering a limited financial resource and a vast scope to be invested in this province, the development project should be prepared for using on several key points to improve the infrastructure and to give the incentive to farmers, so that smooth development can be assured step by step in the future.

CHAPTER III AFFORESTATION PILOT TEST

Toshio TAKAKU
I Gede Made Suantra
Willybrordus Tandi Pong Masak

C O N T E N T S

CHAPTER III Afforestation Pilot Test

III-1 Outline of Indonesian Forestry

III-1-1 Forest condition

Indonesia straddles the equator and consists of many, large and small islands. The total land covers 190,435 thousand hectare (it is five times larger than that of Japan) and the forest area extends to 122,227 thousand hectare (64% of the total land area). Indonesia has ideal climatic conditions for the growth of forests. Abundant sunshine and moisture make for plant rapid growth.Plants and animals need not adapt themselves to severe climate, e.g., temperate zone,arctic zone, although they must compete with each other for the limited space available.

In the tropical forest the numbers and complexity of biological interaction cause the great diversity of plant life. Due to its wet climate and fertile soils, the vegetation of Indonesia consists of approximately 450 genera with about 3.700 species. The tropical rain forest grows even with abundant sunlight and generally plentiful moisture (There is no period of dormancy for plants such as winter in temperate zones). Since the country lies close to the equator, the duration of sunlight varies little from day to day. Even within a day diurnal range (difference of maximum and minimum temperature) changes a little. Thus the average temperature is quite even.

On the other hand, the wet and dry seasons are caused by the seasonal wind. The sun's energy, in relation to the oceans and land masses periodically moves air from one region to another. This solar "Weather machine" forms two seasonal winds or monsoons. The North-West monsoon occurs from November to February; generally much rain falls on major islands such as Sumatera, Java and Kalimantan. The South-East monsoon occurs from July to September, each year causing dry season on the major islands. In highly monsoonal climates such as West Nusa Tenggara. East Nusa Tenggara and also the southern part of Sulawesi where there is little rain, the richness of the forest is limited by the lack of water at this time. Plants of this forest area have adapted to the periodic dryness. An even more extreme dry season results in very open forest and grassland, known as Savannah.

Although the microclimate has been decided by seasonal wind, the climate at the specific place is not so simple. This is why the climate might be affected by various factors, i.e. geographic feature, altitude above sea level, ocean current, and also vegetation etc. For example, when a movement of atmospheric air caused by seasonal wind ascends along the mountain slope, the temperature of air falls at 0.5 - 0.6°C per 100 meter, if it reaches the saturation point of air, air becomes water vapor, and then, raindrops fall. Thus the micro~~scopic~~ climate is affected by many factors; it is very difficult to formulate the microclimate tendency and to forecast weather. naive?

Although the above description is valid for the forests throughout Southeast Asia (and West Africa and central South America as well) we find certain differences where the climatic conditions vary. Differences between the major forest types are caused by variations in rainfall, and also by increases in elevation. By the way, according to Köppen (1923), most significant climatic factors are temperature and aridity index (the potion between dry months and wet months) to determine the climatic zone from the viewpoint of vegetation. And also the edaphic factors which are the physical property, chemical property and moisture of the soil influence the formation of vegetation. The type of formation greatly affected by climate is referred to as the climatic formation, while that effected greatly by the soil condition is called the edaphic formation. The forest types in Indonesia are as follows: Quote Kira.

Climatic formation : a. Tropical rain forest
b. Montane forest
c. Monsoon forest

Edaphic formation : d. Swamp forest
e. Mangrove forest
f. Coastal forest

(1) Tropical Rain Forest:

Also named everwet or humid rainforests, these are the most extensive forests in South East Asia and are dominated by large trees of the family Dipterocarpaceae. Dipterocarps are distinguished by their large pods which whril through the air like helicopters. For Latin enthusiasts: di = two ptero = winged, and carp = fruit. There are about 500 tree species in this large tropical family, and they grow almost exclusively in the rainforests of South East Asia.

In Sumatera, Kalimantan and few smaller islands in Maluku such as Taliabu, Mangole, Mandioli, Sasana and Obi, this forest contains trees of the family Dipterocarpaceae, particularly of the genera Shorea, Dipterocarpus Hopea, Vatica, Drybolanops and Cotylelobium.

Other tree species much found are of the families Lauraceae, Araucariaceae, Leguminosae and also Ebenaceae. In Java and Nusa Tenggara the genera Altingia, Bischfia, Castanopsis, Ficus and Leguminosae. In eastern islands which are separated from the west by deep seas, and the geographical boundary "Wallace Line" comprising Sulawesi, Maluku and Irian, this forest could be called a Mixed forests Plaquium spp, Pometia pinnata, Intsia spp Diospyros spp, Koordersiodendron pinnatum and Canarium spp, are abundantly found.

The forest grows where there is little variation in rainfall, on well-drained soils, and at low to medium elevations. In the low land forest we can see many strange features; large trees with huge buttresses to prevent the trees from falling down, flowers growing directly from tree trunks woody climbers and many parasites which grow on other living plants.

(2) Montane Forest

With an increase in altitude there is a corresponding decrease in average temperature and usually more rainfall. These changes lead to the replacement of Lowland forests by Montane forests, at about 1,000 metre's elevation and over near the equator. The structure of these forests is more compressed and the trees are not so tall (about 25 - 30 m).

The Dipterocarpaceae are mostly replaced by other trees especially in the oak family (Fagaceae). The species commonly found here are Quercus, Castanopsis, Nothofagus, and species from the families Magnoliaceae and Ulmus. Tropical conifer trees (as Agathis, Podocarpus and Dacrydium) are also found.

When the forest is continually bathed in clouds the trees are covered with beautiful green moss. At the highest altitudes, Rhododenrons and huckleberries in shrubs are characteristic. Montane forests occupy a limited area but are very important because they are environments containing some rare and beautiful plants (Orchids are extremely beautiful) and because they efficiently absorb the high rainfall in the montains. In general, there is less diversity in the plant life than in lowland forests and these forests are of no direct commercial value.

(3) Monsoon Forest

In this forest area, the climate is strongly influenced by the southeast monsoon causing dry season. And average annual precipitation ranges from 1,000 to 2,000 mm. The species diversity of this forest type is not as great as that of the lowland rainforest. In Indonesia this forest type is found in Java (particularly in East Java), Nusa Tenggara and part of Sulawesi The tree species characterizing this forest type in Java are e.g. Tectona grandis, Accacia leucophloea, Actinophora fragrans, Albizia chinensis, Azadirachta indica and Caesalpinia digyna. In Nusa Tenggara the tree species characterizing this forest zone are e.g. Eucalyptus alba and Santalum album. Whereas in Maluku and Irian they are Melaleuca leucadendron, Eucalyptus deglupta, Banksia dentata and Carypha uta and Timonius cerycus.

(4) Swamp Forest

Where water does not drain freely from the soil, the resulting forests are different in structure. The tree species in these forests are quite distinct from others and not tall. Many have specialized roots (as stilts and buttresses) to help anchor the plant in the boggy soil. Because of their acid, waterlogged and mineral-poor soil, swamp forests present special problems for agricultural development once they are cleared.

They are found throughout Indonesia in vast areas, particularly in Eastern Sumatera, West Kalimantan and Central Kalimantan, and in the southern part of Irian Jaya. Tree varieties which are much found are Xylopia spp, Calophllum spp, Terminalia spp, Koompasia spp and Canarium spp.

(5) Mangrove Forest

Where the low swampy soil is associated with tidal rivers and estuaries, mangrove swamp forest grow. These are dynamic and rapidly changing environments. Mangrove forests are found best developed along the straits of Malacca, in both West Malaysia and Sumatera. The rapid change in this coast is demonstrated by the fact that Palembang, which was the seaport capital of the Srivijayan Empire about 1,000 years ago, is now over 100 km. away from the sea. Mangrove forest structure is quite simple; an even canopy up to 25 meters high consisting of only a few tree species.

The principal trees such as Rhizophora, Avicennia and Sonneratia have special adaptation to the salt water. Stilt roots assist in anchorage and oxygen exchange, and seedlings begin their development before the fruit leave the trees.

Mangorove forests are very important habitats where fish and shell fish (crabs and prawns) breed. These forests also supply firewood and charcoal for the people who live nearby. As the land becomes drier and the soil water less salty there is a gradual transition from mangrove to lowland Dipterocarp forest.

(6) Coastal Forest

Along the coastalines, limited and unique vegetation grows. Beach forests contain trees specially adapted to the exposed and hot conditions and sandy, rocky soils, above the highest tide line. The trees much found here are Terminalia catappa, Calophyllum inophyllum, Hibiscus tiliaceus Casuarina equisetifolia, and in addition thereto, plenty of Pandanus tectorius are found.

Beside the six types above, there are artificial forests and secondary forests, at about ten odds percentages of the total forest land. Artificial forests are particularly found in Java with the tree species Tectona grandis, Pinus merkusii, Agathis lorantifolia, Altingia exelsa, Schima wallichii, Albizzia falcataria etc. And in Sumatera with Pinus merkusii mainly, also in Sulawesi and Bali, artificial forest has been planted on some extents of area which has already reaches its cutting age.

The extent of forests in Indonesia, according to their types, is as follows.

Table 1 Extent of Forests according to type.

T Y P E	ESTIMATED EXTENT (in million Ha.)
Rain Forest Montane Forest	89.0
Monsoon Forest	2.0
Swamp Forest	13.0
Mangrove Forest	1.0
Coastal Forest	1.0
Secondary Forest	15.7
Others	0.5
T o t a l	122.2

Now, the government tackles the denuded land scattered in the country through reforestation and afforestation projects. It is said that denuded lands extend almost 20 million ha. in Indonesia it is too extensive to realize a sufficient result in a short time. On the other hand forest exploitation by logging company forest clearing by introducing rubbers as a plantation crop, shifting cultivation and firewood collection by local people so far caused the disturbance of forest ecosystem to some extent and then replace virgin forests with new vegetation, e.g. secondary forest.

If it is left as it is without maintenance or rehabilitation forest in Indonesia will be lost in the future.

Table 2 shows the functional classification of forest by Province and forest area as per cent of land area. Forests in Sumatera, Kalimantan and Irian Jaya occupy about 83% of the forest area in Indonesia.

Table 2 FUNCTIONAL CLASSIFICATION OF FOREST BY PROVINCE

Province	Land area	Forest area	Forest area as per cent	Forest area designated for protection	production	nature conservation	reserve forest
1. Aceh	5.539	4.090	73.8	0.352	3.065	0.667	0.006
2. North Sumatera	7.079	4.300	61.4	1.140	1.140	0.238	1.832
3. West Sumatera	4.978	2.360	47.4	1.548	0.742	0.070	—
4. Riau	9.456	6.600	69.8	0.401	6.078	0.121	—
5. Jambi	4.492	3.670	81.7	0.127	2.672	0.257	0.614
6. South Sumatera	10.369	4.660	44.9	0.468	3.332	0.310	0.550
7. Bengkulu	2.117	1.386	65.5	0.350	0.690	0.075	0.270
8. Lampung	3.331	1.304	39.1	0.296	0.341	0.487	0.180
SUMATERA	47.361	28.420	60.0	4.682	18.060	2.226	3.452
9. West Java	4.689	0.935	19.9	0.299	0.423	0.213	—
10. Central Java	3.738	0.642	17.2	0.021	0.615	0.003	0.003
11. East Java	4.792	1.314	27.4	0.259	0.807	0.178	0.070
J A V A	13.219	2.891	21.9	0.579	1.845	0.394	0.073
12. West Kalimantan	14.676	9.760	66.5	1.514	8.211	0.035	—
13. Central Kalimantan	15.260	13.075	85.7	1.053	11.568	0.454	—
14. East Kalimantan	20.244	17.240	85.2	0.001	11.783	0.267	5.189
15. South Kalimantan	3.766	1.395	37.0	0.171	1.154	0.065	0.005
KALIMANTAN	53.946	41.470	76.9	2.739	32.716	0.821	5.194
16. Bali	0.556	0.125	22.5	0.060	0.029	0.022	0.014
17. West Nusa Teng.	2.018	0.848	42.0	0.643	0.125	0.089	—
18. East Nusa Teng.	4.788	1.063	22.2	0.530	0.036	0.057	0.440
BALI & NUSA TENG.	7.362	2.036	27.7	1.224	0.190	0.168	0.454
19. North Sulawesi	1.902	1.384	72.8	0.313	0.508	0.251	0.312
20. Central Sulawesi	6.973	3.588	51.5	0.617	2.600	0.371	—
21. South Sulawesi	7.278	3.222	44.3	1.077	0.677	0.188	1.280
22. South-East Sulawesi	2.769	1.716	62.0	0.939	0.369	0.134	0.274
SULAWESI	18.922	9.910	52.4	2.946	4.154	0.944	1.876
23. Maluku	7.451	6.000	80.5	2.000	3.859	0.069	0.072
24. Irian Jaya	42.198	31.500	74.6	0.011	2.838	3.288	25.313
25. East Timor	1.499	—	-	—	—	—	—
INDONESIA	191.957	122.227	63.7	14.181	63.712	7.910	36.425

Sources : FACTS & FIGURE. Forestry in Indonesia 1980
DIRECTORATE GENERAL OF FORESTRY

III-1-2 Forest Potentialities

Among the ASEAN countries, Indonesia has the richest and largest forest. We can understand that Indonesia occupies a very highly place in the world as regards the forestry resources. Table 3 shows the position of Indonesia Land-use among ASEAN countries.
(DATA presumably stem from mixed sources, and a little bit old)

Table 3 LAND USE ESTIMATES within ASEAN COUNTRIES in million ha.

INDONESIA		TOTAL AREA	190,435
	Forest	122.200	(64,1%)
	Wasteland	13.800	(7,2%)
	Swamp	1.900	(1,0%)
	Agriculture	12.700	(6,7%)
	Rice	7.000	(3,7%)
	Other	2.000	(1,0%)
	Nature Reserves	32.000	(16,8%)
MALAYSIA		TOTAL AREA	35,505
	Forest	21,500	(60,8%)
	Wasteland	4,700	(13,2%)
	Swamp	3,600	(10,1%)
	Agriculture	5,400	(15,2%)
	Rice	0,657	(1,8%)
	Other	0,200	(0,5%)
	Nature Reserves	0,650	(1,9%)
PHILIPPINES		TOTAL AREA	29,033
	Forest	14,500	(49,9%)
	Wasteland	3,600	(12,4%)
	Swamp	0,215	(0,7%)
	Agriculture	10,400	(35,9%)
	Rice	3,500	(12,0%)
	Other	0,318	(1,01%)
	Nature Reserves	0,030	(0,1%)
THAILAND		TOTAL AREA	51,400
	Forest	26,928	(52,5%)
	Wasteland & Swamp	12,220	(23,8%)
	Agriculture	12,000	(23,3%)
	Rice	7,520	(14,6%)
	Other	0,250	(0,4%)
	Nature Reserves	0,481	(1,0%)

Source : " The Sinking Ark " Environmental Problems in Malaysia & South East Asia 1975

The artificial forests which have reached their cutting age exist only in Sumatera, Java, Sulawesi and Bali as already mentioned. Among them, teak (<u>Tectona grandis</u>) forest in Java especially in Central and East Java is very famous. It has very long history and its management system has been already established during Dutch occupation. As for this point, Java is the most advanced forestry area in Indonesia.

Table 4 <u>Forest potentiality in Productive area within the coming 20 years</u>

(1) Artificial Forest — Upper / lower ; Extent x 1.000 Ha. / volume x 1.000 m³

Species \ Island	Sumatera	Jawa	Kalimantan	Sulawesi	Maluku	Bali & N.T	Irian Jaya	Indonesia
Teak		761 / 76.100		7 / 525		6 / 300		774 / 76.925
Conifer	150 / 15.000	145 / 14.500				3 / 225		298 / 29.725
Mixed	24 / 2.400	85 / 8.500		4 / 300		18 / 1.170		131 / 12.370
Artificial forest Total	174 / 17.400	991 / 99.100		11 / 825		27 / 1.695		1.203 / 119.020

(2) Natural Forest — Upper / lower ; volume per ha. / volume x 1.000 m³

use \ island	Sumatera	Jawa	Kalimantan	Sulawesi	Maluku	Bali & N.T	Irian Jaya	Indonesia
For Export	35 / 258.510		40 / 611.640	39 / 38.961	90 / 140.940	27 / 378	25 / 91.600	39 / 1.142.029
For Domestic	44 / 324.984		28 / 428.156	29 / 28.971	5 / 7.830	97 / 1.358	9 / 32.976	28 / 824.265
Others	8 / 59.008		15 / 198.783	6 / 5.994	10 / 15.660	14 / 196	78 / 258.792	20 / 565.433

(3) Natural Forest in Total — Upper / lower ; Extent x 1.000 ha. / volume x 1.000 m³

	Sumatera	Jawa	Kalimantan	Sulawesi	Maluku	Bali & N.T	Irian Jaya	Indonesia
Natural Forest Total	7.386 / 642.528		15.291 / 1.238.571	999 / 73.926	1.566 / 164.430	14 / 1.432	3.664 / 403.430	28.290 / 2.524.871

(4) Grand Total — Upper / lower ; Extent x 1.000 ha. / volume x 1.000 m³

	Sumatera	Jawa	Kalimantan	Sulawesi	Maluku	Bali & N.T	Irian Jaya	Indonesia
Grand Total	7.386 / 659.982	991 / 99.100	15.291 / 1.238.571	1.010 / 74.751	1.566 / 164.430	41 / 3.627	3.664 / 403.430	30.123 / 2.643.891

Source : Draft for the Forestry Master Plan of 1972 - 1991

In the meantime, the natural forest as for potentiality exists on three main islands with its richness and vast area. From the commercial point of view, Dipterocarpus species and some Agathis are already famous for their value, but some mixed wood such as in Irian Jaya has not yet been known by the processing company and user. Utilization of unknown tree species is one of the tasks of Indonesian forestry.

The table 4 shows the estimation of the longrange prospect of forest production. This longrange prospect might be reviewed by the Government as the log export will be controled in the near future. With the Government forestry policy to increase domestic processing and to raise additional value, log export has been limited to some extent from middle '70 s , when SEALPA (South East Asia Lumber Producer's Association) was founded within Indonesia, Malaysia and the Phillipines.

SEALPA aims its strong control on log export so as to serve the best interests of the nation, and to do fair business with demanding countries. Recently log export has decreased since 1979. And in the near future, log export will be banned. Domestic processing such as Venner, sawn timber and other forest production is taking its place to aim at harmonized forest development in Indonesia.

From results of field exploration in the context of forest exploitation outside Java, temporary data on the average volume are obtained.

Table 5 shows the standing stocks by main species.

Table 5 Standing Stocks by main species

Island / Species	Volume at Ø . of 50 cm. over* (m^3/ha.)	Distribution
A. SUMATERA		
1. Dipterocarpaceae, dominated by genera of Shorea, Hopea, Anisoptera, Vatica and Dipterocarpus.	40 - 80	From Southern Aceh, Lampung.
2. Pinus merkusii (natural)	100 (35 cm. / over)	Aceh, North Sumatera
3. Rhizophora (mangrove)	60**	Along the eastern shore and the eastern island, mainly Riau.
4. Eusideroxylon zwageri	-	Sporadic in Palembang, Jambi.
B. KALIMANTAN		
1. Dipterocarpaceae, composition as in Sumatera	45 - 160 30 - 100	Eastern, Central and Western Kalimantan
2. Gonystylus (Ramin)	6 - 100	West and Central Kalimantan
3. Eusideroxylon zwageri	30 - 60	South and East Kalimantan
4. Agathis borneensis	10 - 150	
5. Rhizophora	-	Along the eastern coast of Kalimantan and part of the south southern coast.
C. SULAWESI		
1. Dipterocarpaceae (gen. Hopea and Vatica)	30 - 45	
2. Intsia	40 -	Mainly in Central part
3. Diospyros (ebony)	30 - 40	Along Tominy gulf and Central Sulawesi
4. Agathis sp.	± 100	North Sulawesi, Central and Southeast Sulawesi
D. MALUKU		
1. Dipterocarpaceae, mostly Shorea celanica and Vatica sp.	± 120	Ceram, Obi, Sula, Halmahera
2. Canarium and Eucalyptus		Halmahera, Ceram
3. Mostly found Dipterocarpaceae is Vatica, mixed with non-dipterocarpaceae such as Pometia, Intsia, Eugenia	± 60	
4. Agathis	± 60	
5. Intsia	± 60	
6. Rhizophora	± 60	Along the west coast

*) Except Pinus and Rhizophora

**) Volume at mature age for cutting

Now we will take into consideration the past achievement. The following table shows forestry production and log export and the next to following table shows timber export by country of destination. During the past 10 years, Indonesia exports almost all wood production to the world market, especially to Japan.

Table 6 Wood Production and Log EXPORT

in thousand m^3

Year	Teak	Non-teak	Total	Log export	Conversions	Total
1969	519	5.507	6.026	3.673	29	3.703
1970	609	10.290	10.899	7.303	46	7.350
1971	514	13.192	13.706	10.608	81	10.761
1972	634	17.083	17.717	13.759	132	13.891
1973	676	25.621	26.297	19.095	338	19.433
1974	620	22.660	23.280	17.728	354	18.082
1975	595	15.701	16.296	13.510	410	13.921
1976	480	21.920	21.427	17.877	644	18.521
1977	573	22.366	22.939	19.212	594	19.806
1978	475	25.780	26,255	19.443	756	20.199
1979	575	24.042	24.617	18.205	1.284	19.489

Table 7 Timber Export by Country of Destination

in thousand m^3

Year / Country	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
Japan	2.669	6.134	8.384	9.687	12.166	12.187	75.587	9.936	9.483	9.238	9.708
South Korea	186	450	975	1.520	2.001	2.136	2.741	3.501	4.829	5.187	4.449
Taiwan	204	348	993	1.240	2.172	2.227	2.136	2.581	3.369	3.432	2.569
Singapore	118	279	286	498	1.488	819	755	1.026	1.127	1.396	1.412
Italy	209	182	287	333	393	253	221	489	296	356	405
Others	429	237	126	612	651	487	454	992	703	590	946
Total	3.075	7.350	10.761	13.891	19.433	18.082	13.921	18.521	19.867	20.199	19.489

Table 8 shows timber export by tree species and by use

Table 8 Timber Export By Tree Species, 1974 - 1979

(in thousand m^3)

Year / Species	1974	1975	1976	1977	1978	1979
Meranti	10.641	9.491	11.956	12.553	13.346	11.480
Ramin	922	800	1.273	1.143	1.107	756
Agathis	339	353	410	372	258	361
T e a k	72	40	51	73	52	30
Pulai	323	165	532	791	554	342
Kapur Keruing	1.513	1.426	1.889	1.997	2.145	2.284
Duabanga sp.	---	45	68	78	72	47
Ebony	---	16	18	19	23	3
Pulp Wood	---	89	174	279	383	396
Others	4.272	1.496	2.149	2.501	2.259	3.790
T o t a l	18.082	13.921	18.521	19.992	20.199	19.489

As for pulp and paper industry, about 70 % of the papers are imported from overseas, and also imported pulp are used for paper factory. Paper consumption may be regarded as cultural barometer of the nation. Compared the values of paper comsumption per capita in neighboring countries, that of Indonesia; 3.2 kg. year, is the lowest one (Singapore 60.0 kg, Malaysia 20.0 kg. Philippines 10.0 kg. Thailand 6.3 kg, Japan 140.0 kg and U.S.A. 274 kg) 1978. Paper consumption.

Paper consumption in Indonesia ,however, will increase in the near future as the standard of education rises.

III-1-3 Forestry Policy.

General forest legislation is contained in the Basic Law of Forestry, Law No. 5, 1967 (Undang - Undang Pokok Kehutanan No. 5). In the meantime detailed instruction is given in regulations issued by the President, the Minister of Agriculture, the Director General of Forestry and Provincial authorities. The aim of forest utilization is to maximize production within harmonized development of natural resources and marketing of forest products such as timber, rattan, bamboo and resin under sustained yield and multiple use management. Of equal importance are soil conservation, erosion and flood control and protection of the ecosystem.

According to the explanation on the Basic Low of Forestry, function of forest are described as follows;

1. Control of water regulation, prevention and limitation of floods and erosion, and conservation of soil fertility.
2. Production of forest products to meet local demands in general for construction, industry and export in particular.
3. To facilitate the development of the National Economy in general and to promote the forest product industry in particular.
4. Preservation of favourable conditions and establishment of good influence.
5. Making available scenic natures in general, especially in the form of Natural Resources, Wildlife preservation, Recreational Parks and Hunting Parks for the benefits of science, education, culture and tourism.
6. It is considered as an element of the National Defense Strategy.
7. Providing other benefits usable for the public.

On the other hand, according to its function, the forest can be distinguished into four categories, considering the aspects of economy in general character of the surrounding nature and other exceptional properties;

1. "Protection Forest"

that is a forest favored with a nature providing beneficial influence on the soil; surrounding nature and water regulation should therefore be preserved and protected. When these Protection Forests are disturbed, they will loose their protective function, and eventually, natural disaster will result such as floods, erosion etc. Several of these Protection Forests are still capable of limited production which because of its natural condition does harm its protective function.

2. "Production Forest"

is a forest favored with a nature and capability which render them suitable for products. The harvesting of these forests regulated on a sustained yield basis.

3. "Reservation Forest"

is a forest district favored with a nature of such quality as to render them important for the interest of science & culture. Therefore these forest districts should be given special treatment. Forests are classified into Natural Reserves & Wildlife Preservation.

4. "Recreational Forest"

is a forest favored with nature of exceptional beauty, therefore has a potency to be developed specially for the interest of tourism and or hunting Parks.

"Forest districts" are described as regions already forested or unforested, declared to be designated as forests. All these forest districts are regions, the use of which in the field of forestry has been stipulated in the frame of "land-use planning" based on the needs and interests of Indonesia public. Total area of forest districts should be sufficiently large, and distributed evenly, either for production, protection or for other benefits. In conformity with their designation, forests can be distinguished into three main categories;

1. "Permanent forests", i.e. forests, either already established or still to be planted, or those occurring naturally in the forest districts.
2. "Forest reserves", i.e. forests found outside forest districts, the use of which has not yet been designated, and which are not under private owner ship. When considered necessary, these forest reserves can be sanctioned into permanent forests.
3. "Other forests", i.e. forests outside Forest Districts and outside Forest Reserves, such as those growing on private lands or on lands under other kinds of rights.

The Basic Law describes forest management and its main activities as follows;

1. Regulation and implementation of forest protection, sanctioning, supervision, development and reforestation.

2. Implementation of forest inventory
3. Conducting investigation and research regarding the forests products, and investigation into the social economy of the people living in and around the forests
4. Organizing and conducting extension and education in the field of forestry

Management of state forests is then carried out by executive agencies and is stipulated further by the Minister. Detailed explanation of the Organizational Structure of the Directorate General of Forestry is as follows;

Its main task is to carry out part of the main tasks of the Ministry of Agriculture, i.e. in the forestry realm, based on the policy stipulated by the Minister of Agriculture.

a. Formulation of Technical policy, giving guidance & counselling, extending permits in accordance with the policy stipulated by the Minister and based on the regulation in force
b. Performance of its main task in accordance with the legislation in force
c. Technical security for the accomlishment of its main task
d. Management of the Planology Brigade and Ground Units and the State's natural conservation units under Ministry of Agriculture

In accomplishing the above-mentioned task and function, the Directorate General of Forestry is assisted by Directorates and their sub-divisions:

1. Secretariate of Directorate General;
2. Directorate for Program Establishment;
3. Directorate for Production;
4. Directorate for Facility Improvement;
5. Directorate for Reforestation and Forest Restoration; and
6. Directorate for Nature Conservation and Safeguarding.

And part of its authority is delegated to the Provincial Government. Additional, a state-owned forest enterprise has been established as a production unit, aiming to manage the forest in line with governmental policy to increase national revenue by planting, treatment, protecting, exploiting, processing and marketing of forests and forest products, mainly teak in Central and East Java.

By the way, forest exploitation is carried out by private companies after obtaining the H.P.H. (Forest Exploitation Right) from the Directorate General of Forestry (if the concession area is 100 ha. or more). In order to export logs, a licence fee should be paid for the forest development concession and timber royalties to the Government. But in this procedure, the country which has its natural resources will lose her wealth, because the amount and the price of logs are controlled one sidedly according to the economic conditions of the importing country. It is thus impossible to keep a harmonized and planned development of forest resources, as the importing country usually has much money and power, while on the other hand the producing country does not. It is not a fair business.

Recently, a joint decree of three ministers (Agriculture, Trade and Industry Ministers) has stipulated the prohibition of log exports, the establishment of processed wood mills and plywood mills.

And reportedly, Indonesia will reduce its log exports by about 1.5 million cubic meters annually starting this year, and intends to totally end the export of the commodity by 1985. The government intends to boost the exports of processed or semi-processed wood products rather than log form. However, this is a worldwide tendency, the importing country such as Japan, Taiwan and South Korea will be affected by this decision.

III-2 Present situation of Forestry in South Sulawesi

III-2-1 Forest Resources and Production

Approximately 41 per cent of the total area of South Sulawesi is designated as forests under the jurisdiction of the Forestry Service. The primary forests consist of tropical rain forests and monsoon forests. The latter occur in areas with pronounced dry seasons along the south and west coasts as well as in the inland. Montane Forests exist on high mountainous areas such as Latimojong mountain ranges. Mangrove forests are mainly found along the east coast and some swamp forests occur in coastal areas. The major commercial species in the tropical rain forests are mersawa (Anisoptera spp.) nantu (Palaquium spp.) sipate (Alstonia spp.), bintangur (Calophyllum - dasypedum) and durian (Durio zibethinus). The commercial monsoon forest species are ebony, palapi (Madhuca philippinensis), bakata (Haplclobus - celebicus) and damar (Agathis spp.) The forest are divided into permanent forests and forest reserves. The latter can be converted, at least in part into agricultural use. The distribution of forest areas by Kabupaten is given in table 9.

Table 9 AREAS OF PERMANENT FORESTS AND FOREST RESERVES BY KABUPATEN FOREST DISTRICT

(ha.)

Kabupaten Forest District	Permanent Forest	Forest Reserve	Total Forest	Area
Bantaeng	8.469	66	8.535	47.000
Barru	89.585	0	89.585	92.400
Bone	162.995	0	162.995	455.500
Bulukumba	5.000	62.241	67.241	128.000
Enrekang	55.130	5.000	60.130	149.100
G o a	68.449	1.374	70.323	169.522
Jeneponto	15.874	42	15.916	79.000
Luwu	649.374	690.780	1.337.127	2.434.900
Majene	70.000	0	70.000	193.200
Mamuju	600.000	0	600.000	1.240.700
Maros	22.928	1.600	24.528	153.190
Pangkep	16.900	550	17.450	79.765
Pinrang	63.640	0	63.640	250.851
Polmas	248.000	0	248.000	998.500
Selayar	18.000	0	18.000	22.420
Sidrap	71.145	0	71.145	233.974
Sinjai	21.500	1.438	22.938	102.539
Soppeng	49.000	0	49.000	150.000
Takalar	19.488	0	19.488	45.000
Tana Toraja	149.695	7.900	154.595	423.360
W a j o	14.214	33.000	47.214	242.202
Pare-Pare muni.-cipality	4.300	0	4.300	11.077
T o t a l	2.418.119	803.991	3.222.110	7.763.767

The permanent forest are devided into production protection, nature reserve and recreation areas. Production forests are located in only five Kabupaten-s; Bone (4,315 ha.), Luwu (247,500 ha.), Mamuju (410,360 ha.), Selayar (18,000 ha.) and Takalar (3,875 ha.). Limited exploitation is permitted in some protection forests. The major nature reserve in the province, near Bantimurung in Kabupaten Maros, is an ecological reserve consisting of rare limestone formation with characteristic flora and rare butterflies.

Although many species occur in the forests, only few are commercially valuable. Surveys in concession areas indicates an average of 102.0 cu. metres of timber per ha. (diameter over 50 cm) of which the most valuable species, Agathis and Dipterocarpus amount to some 5 per cent. Large concentrations of Agathis occur north of Malili and concentrations of Dipterocarps occur near Palopo. Timber concessions of 100 ha. or larger are granted by the central government. Cutting permits for smaller areas are the responsibility of the provincial government.

In South Sulawesi forest exploitation is carried out by a third party (private business) acquiring the right for forest exploitation, permit for forest product harvesting and a joint contract for the processing of forest products. Forest exploitation right holders in South Sulawesi number to 10, covering an area of 604,000 ha., of which 228,000 ha. lies in Kabupaten Luwu and 376,000 ha. in kabupaten Mamuju. Of the above number, 4 holders are actively producing. Beside the above activity, forest product processing is also conducted, i.e. under a joint contract between the Provincial Level Forestry Service and private enterprises. The wood varieties they deal with are mangrove and ebony.

Supervision of the Right for Forest Exploitation (HPH) is one of the sub-projects on forest safeguarding financed by the South Sulawesi Provincial Administration. Supervision results show that duties entailed to the HPH, such as boundary arrangements, forest renovation and felling regulation have not been observed as they should.

Forest production in South Sulawesi comprises wood and non-wood. For export, production is restricted to the extent of logs, and for local consumption it takes the form of timber. Additionally, forests produce 4th and 5th grade wood as firewood, raw materials for the Gowa Paper Factory and for the Palopo Plywood Industry.

The wood types are e.g. Accacia decurrens, Calophyllum waworunti kds. (bituang), and what is known by the local name Sipati, and Durian. Non-wood products are particularly rattan and copal which are export commodities. Wood production during 1978/'79 amounted to 101,698.538 m³ comprising mix wood, ebony and mangrove. HPH holders have attained a total production of 79,819.13 m³

Industrial Developments in the Forestry realm are as follows;

a. Gowa Paper Factory at Borongloe, Kabupaten Gowa. It has worked since 1973 hitherto at an average production rate of 50 tons a day. Raw materials are : bamboo from the 24,000 ha. bamboo forest at Borisallo, Accacia sp. and Rhizophora sp. purchased from private companies.
b. Palopo Plywood Industry : established since 1967, financed on a war compensation amounting to $ 4,410,325; starting production in 1973 to cease in 1975 due to the contractor's withdrawal. Production once achieved in January 1975 was 676.98 plywood sheets occupying a volume of 9,038.55 m³; a concession forest area of about 15.000 ha. has been available in Kabupaten Luwu for the supply of raw materials. At the close of 1978 the factory reoperated under a new contractor; for the continuous supply of raw materials for this factory, the concession forest area ought to be expanded.
c. An Ebony sawmill is located in Ujung Pandang. It has worked since October 1974, producing pole blocks, beans and shelves. Raw materials are delivered from South-east Sulawesi besides from South Sulawesi.
d. A saw mill in Malili. Established in 1970, producing shelves and beams for local markets. Raw materials come from a 125,000 ha. large concession area. In 1978/'79 the production ceased due troubles in marketing and capital.
e. Rattan processing.

Beside the Pilot Project for rattan processing belonging to the Forestry Service there is a private-owned rattan processing project, but its development is unknown. This pilot project undertakes rattan processing experiments, from rattan rods into half-ready goods, but it has not run properly due to the following shortcomings :

- The project is too distantly situated from the harbor, far from the range of electricity, the acces road is yet unpaved and it lies outside the industrial territory according to the Ujung Pandang municipal Master Plan.

- Shortage of transportation means
- Restrictedness of electric power
- Trouble of raw materials because of the limitedness of rattan diameter workable by the Project's machinery, i.e. diameter of 10 - 17 mm.

Table 10 shows the forest production in South Sulawesi in 1978/1979.

Table 10. Forest production and export in South Sulawesi 1978/1979

	Mixed Wood (m^3)	Ebony (m^3)	Mangrove (m^3)	Total amount (m^3)	Rattan (ton)
Production	79.982	3.910	17.846	101.738	19.064
Export	75.027	4.553	17.846	97.426	28.776

III-2-2 Afforestation and Reforestation.

The South Sulawesi Province, which extends 7.5 million ha. and has a population of about 6 million, has always been an agricultural region, and it is even called the "food barn" for Eastern Indonesia because of its rich rice production, sufficing for the supply of the minus in Eastern Indonesia. However, the main limiting factor in the effort of increasing rice production is water use. Of the paddy fields in South Sulawesi extending about 590,000 ha., only half are technically or semi-technically irrigated, while the rest are rainfed or have simple irrigation termed "Desa irrigation"

Besides the lack of water, other limiting factors against paddy production are floods and erosions occurring each year in this province, which damage agricultural products as well as other development products.

Another fact is that Benteng weir in Kabupaten Pinrang, at an irrigation capacity of about 60,000 ha., which was built at the Saddang river in 1940 and had a discharge of 100 m^3/second at the time of construction, has decreased to 45 - 50 m^3/second by 1980 (Both figures are in the dry season. This information is given by the South Sulawesi Province Public Work Service). With the decrease in water discharge, irrigation capacity has also decreased, from the aspect of natural condition. This implies, too, that bare and critical lands in the Saddang watershed area is still increasing.

Realizing the role of South Sulawesi as one of the food barns of Indonesia, the Central Government has given this region a high priority to improve its water use and its living environment through reforestation and restoration of critical lands in the program for soil and water conservation performed by the Directorate General of Forestry.

The program for soil and water conservation has been executed in South Sulawesi since Pelita I in a small scale. Then it was enhanced greatly in 1976/'77 through the Presidential Instruction No. 8/1976. In order to achieve a large-scale target, a specific budget is provided, and execution is burdened on 6 Ministers (respectively, Agricultural, Home Affairs, Finance, Public Works and Electric Power, National Development Planning Board-BAPPENAS, and Living Environment) in the form of a joint Decree.

It was through this Joint Decree of 1976/'77 that the D.A.S. (Project for the Planning and Establishment of Reforestation and Afforestation of the watershed area) was founded, with the following major tasks:

a). Five years planning of afforestation and reforestation
b). Annual Technical Plan
c). Recording and Reporting of the work results
d). Guidance and Counselling for the performers

The assistance program for reforestation and afforestation is executed in the territorial units of watershed area which are natural units easily identified as to their borders, both in the field and on maps. Many watershed areas are found in South Sulawesi, large and small ones, but the major watershed areas are the following :

1. Saddang Watershed Area (DAS SADDANG);
2. Jeneberang Watershed Area (DAS JENEBERANG); and
3. Bila-Walanae Watershed Area (DAS BILA WALANAE).

The Aid Program is divided into two categories: Reforestation and Afforestation.

Reforestation in South Sulawesi has been performed since 1923/1924 in the regions of Gowa and Jeneponto, initiated experimentally on an area extending 2 - 10 ha., with plants such as Casuarina, Tristania, Eucalyptus, Albizia falcata and Tectona grandis.

The first effort of reforestation in DAS Saddang was made in Tana-Toraja in 1932/1933 with Mecademia species to an extent of 23 ha., followed in 1938/1939 with Pinus merkusii and Agathis lorantifolia.

The planting was expanded by 87 ha. in 1941/1942, in addition to trials with other species such as Elmerillia ovalis, Albizia falcata and Acacia decurrens. In the following years the planting area of P. merkusii was increasingly expanded at a minor target. The main objective of reforestation in DAS Saddang started in Tator was of hydro-orological nature, in relation to the completion of the Benteng weir in 1940, contemplated to irrigate about 60,000 ha. of paddy fields. Tana Toraja is selected as main target because approximately 48% of the watershed area lies in this kabupaten. Selected as plant locations were remotely separated mountain hilltop, for the purpose of transmitting mycorrhiza and mother tree establishment, to develop long-range generation. Reforestation in Kabupaten Enrekang was just commenced in 1962/1963 with P. merkusii which was afterwards expanded each year. Kabupaten Polmas started reforestation in 1965/1966 with Albizia falcata, and not until 1968/1969 did Kabupaten Pinrang follow, with Mahogany, Accacia auriculiformis and Eucalyptus.

Afforestation in DAS Saddang was started in the first year of Pelita I with the Project no. 10/1969 of the Ministry of Agriculture.

Table 11.

Bare land and Reforestation Plan in the DAS Saddang

- Within Forestry territory (ha) -

	Bare/critical land	Reforested before 76/77	Reforestation Plan 77/78	78/79	79/80	80/81	81/82	82/83
Tana Toraja	47.100	14.031	4.000	8.300	6.300	6.300	5.600	2.569
Enrekang	11.300	4.050	2.600	3.680	600	—	370	—
Pinrang	25.000	2.500	1.800	2.820	6.000	6.000	5.500	380
Polmas	12.000	690	3.000	5.200	2.000	2.000	1.000	110
Total	95.400	21.271	11.400	18.000	14.900	14.300	12.470	3.039

Bare land and Afforestation Plan in the DAS Saddang

- Outside Forestry territory (ha) -

	Bare/critical land	Afforested before 76/77	Afforestation Plan 77/78	78/79	79/80	80/81	81/82	82/83
Tana Toraja	62.000	7.827	10.100	13.450	10.500	10.700	5.900	3.523
Enrekang	23.900	2.715	6.600	7.600	2.800	1.200	—	1.292
Pinrang	4.600	—	2.900	800	200	—	—	200
Polmas	44.500	1.058	10.600	10.600	7.800	5.000	5.000	358
Total	134.000	11.600	30.200	31.650	21.300	16.900	10.900	5.373

Source : "Bagan - Kerja DAS Saddang" 1976/77

Table 12. Distinction between Afforestation and Reforestation

Item	Afforestation	Reforestation
Location	On people's land or free national land	On Forest territory
Plant variety	Various useful plants fitting the local economy such as fruits. ; Accacia, Calliandra, Cashew-nut, Clove etc.	Forest plants in general, for industrial and construction wood ; Pinus, Eucalyptus, Johar Suren, Teak, etc.
Plant spacing	5 x 5 m = 400 trees/Ha.	3 x 2 m = 1650/trees/Ha.
Nursery by	Agriculture Extension Service.	Forestry service/Contractor
Performed by	Bupati, Camat, Villagers.	Forestry service/Contractor
Planting cost	Rp 32,000/ha.	Rp 44,000/ha.
Nursery cost	Rp 2,500,000/ha (1 ha = 400,000 seedlings)	Rp 3,600,000/ha
Target	a) Permanent bare lands; - grass/sedge-grassland - non-vegetated, denuded lands - livestock grazing lands b) Temporarily bare lands; - cultivated lands for secondary crops - rotational cultivated lands - upland fields and dry arable fields with sloping surface	- Area grown underbushes - Bare/critical area - Ex clear cut area - Ex shifting cultivation area - Ex burned area - Area damaged by natural catastrophes and by other causes(landslides, storm etc) - Area failed to be reforested (after evaluation)

III-3 General Condition of the Pilot Test site and its surroundings

III-3-1 Location.

The Pilot Test site situated geographically at 119° 53' 43" Eastern longitude, 3° 16' 54" Southern Latitude (The figures were calculated by proportional allotment method from the topographic map "Makale Celebbes, 1 :125,000" , 1943), and administratively in Desa Buntu Barana northern part of Kabupaten Enrekang, under the Kecamatan of Alla. If we start from Ujung Pandang by road, we go along Ujung Pandang - Rantepao National highway to the north until the 283.5 km. point, and turn to the right following the project road, about 3 km. inside. It is the Pilot Test site, about 7 hours' ride from Ujung Pandang.

III-3-2 Situation and Topography.

Macro-topographically, the terrain around the Pilot Test site is an undulated - rugged area which is hilly to mountainous. Only a minor part is slightly level. To the east rises G. Sinaji - Latimojong mountain range, at an altitude of about 3,000 meter above sea level. The highest peak is G. Rantemario, 3,440 m. a.s.l. The national road extends South-North following the Mata Allo river which runs down to the south, and meets the Saddang River at Enrekang town. The land opens slightly to the south. The rugged mountain range which consists totally of limestone, at an elevation of 1,000 to 1,250 m. a.s.l., runs in the South-north direction. To the north, hilly topography stretches to the Toraja Highland.

The Pilot Test site lies at the hill foot of Mt. Rantemario, at an altitude of around 900 m. a.s.l. The terrain is a sloping area hemmed between two small rivers.

III-3-3 Vegetation.

Grassland cover the area; these grasslands are considered to be generated by artificial influence such as traditional shifting cultivation, grazing cattle and wood collection from forests in the past, either for fuel or for construction. The land has thereafter been so neglected and little rehabilitated that bare lands are widespread in the area. Then original vegetation is supposed to have been forests judging from sufficient rainfall in this area.

Virgin forests appear at the higher part, from an altitude of about 2,000 meter a.s.l. until the peak of Mt. Pantemario. The main species found are Castanopsis spp, Quercus spp., Ficus spp., Casuarina spp., Leptospermum spp., and tropical pine (Agathis, Podocarpus). So this forest is classified as Montane forest. The lower part of the forest, below the 2,000 meter's altitude, has been converted into secondary forest. Saurauia sp, Anthocephalus cadamba, Albizia spp., and Alpitonia incana are found in this forest.

Various secondary forests, both large and small, appear along the valley in the grassland area. In part of the grassland, some Pinus merkusii and clove have been grown; pine forests are established generally in the critical area through Presidential Instruction or DAS Project and clove plantations are made on the relatively rich soil by farmers in the area. About 40 kinds of herbage are found in the grassland, including 3 orchids found by Mr. TANDO (short-term expert on ecology). Some ferns grow in poor soil.

Many fruit species are grown around the homeyards, e.g. Durian (Durio zibethinus), Nangka (Artocarpus integra), Cashew-nut (Anacardium occidentale), cacao (Theobroma cacao), Rambutan (Nephelium lapaceum); cassava (Manihot utilissima) is also grown.

III-3-4 S o i l

Soil types found around the Pilot Test area are Mediterranean and Podsolic soil in hilly to mountainous area. The soil is very cohesive clay soil, and the soil layer is very shallow; sometimes bed rocks appear at the surface of the earth. If the soil gets wet, it becomes very muddy. Bed rocks are immature, incomplete clay stones. Although looking like slate, they are easily broken into fragments when weathered by air, sunshine and rain, and eventually becomes clay soil.

As for chemical condition, the soil is infertile; pH value is around 4.5 - 5.0 by handy pH-meter and nutritious substances are deficient. Whereas for physical condition, refer to the following table, quoted from Mr. CHIKAARASHI's report (May 1981; short-term expert on land and water conservation);

Table 13. Soil hardness and Infiltration Rate at the Pilot Test site

Plot No.	Date	Soil Hardness (kg / cm^2) Sampling Depth			Infiltration rate (mm / 30 min.)	Remarks
		5 cm.	30 cm.	80 cm.		
1	May 9	5 - 7	10 - 15	10 - 11	20 - 15	Hilltop
2	"	5 - 6	8 - 9	9	5 - 12	Midslope
3	"	2 - 8	5 - 8	5 - 7	1 - 2	Lowland
4	"	5 - 8	4 - 7	5 - 8		Steep slope
5	"	6 - 7	4 - 9	5 - 6		"

The value of soil hardness varies from 5 to 15 kg / cm^2, showing quite a higher value than that in Japan, where it ranges only from 0.6 to 2.3 kg / cm^2, the mean value being around 1.5 kg / cm^2. It means that soil at the Pilot Test site is very hard. As for infiltration rate, it shows at least 50 mm / 30 minutes in good forest soil, and at most 200 mm / 30 minutes. Compared with these, the infiltration rate at the Pilot Test site is extraordinarily small.

III-3-5 Geology.

From Enrekang to Tana Toraja, plenty of huge, fantastically and threateningly shaped rocks made of limestone, are seen. But in Desa Buntu Barana there is neither limestone nor rock, and only shale are seen.

According to the "Geologic Map of Indonesia", Ujung Pandang sheet VIII, Directorate General of Mines, 1975, this area is included in the Toraja Formation. Red and Grey shale, marly shale, limestone, quarts sandstone and conglomerate, locally contains coal. Fossils range in age from middle Eocene to middle Oligocene

To the eastern part it is included in the sedimentary rocks, undivided shale and slate, black, grey, green and red, intercalated with greywacke, arkosic sandstone, conglomerate, limestone, marl, radiolarian chert and some phyllite and quarzite. The western part of Central Sulawesi and the south-west part unit locally contains basaltic and andesitic volcanic rocks and acidic to basic intrusives. Rocks near large intrusions are strongly metamorphosed. Most rocks are barren of fossils, but fossils of Cretaceous age are found in boulders, thought to have been derived from the west unit of Latimojong mountain.

III-3-6 Climate.

Meteorological survey was started since February 1980 for temperature and rainfall, at the Desa Chief's house. Additionally we constructed a new meteorological station at the Training Center, and started survey in February 1981, making use of the following equipment:

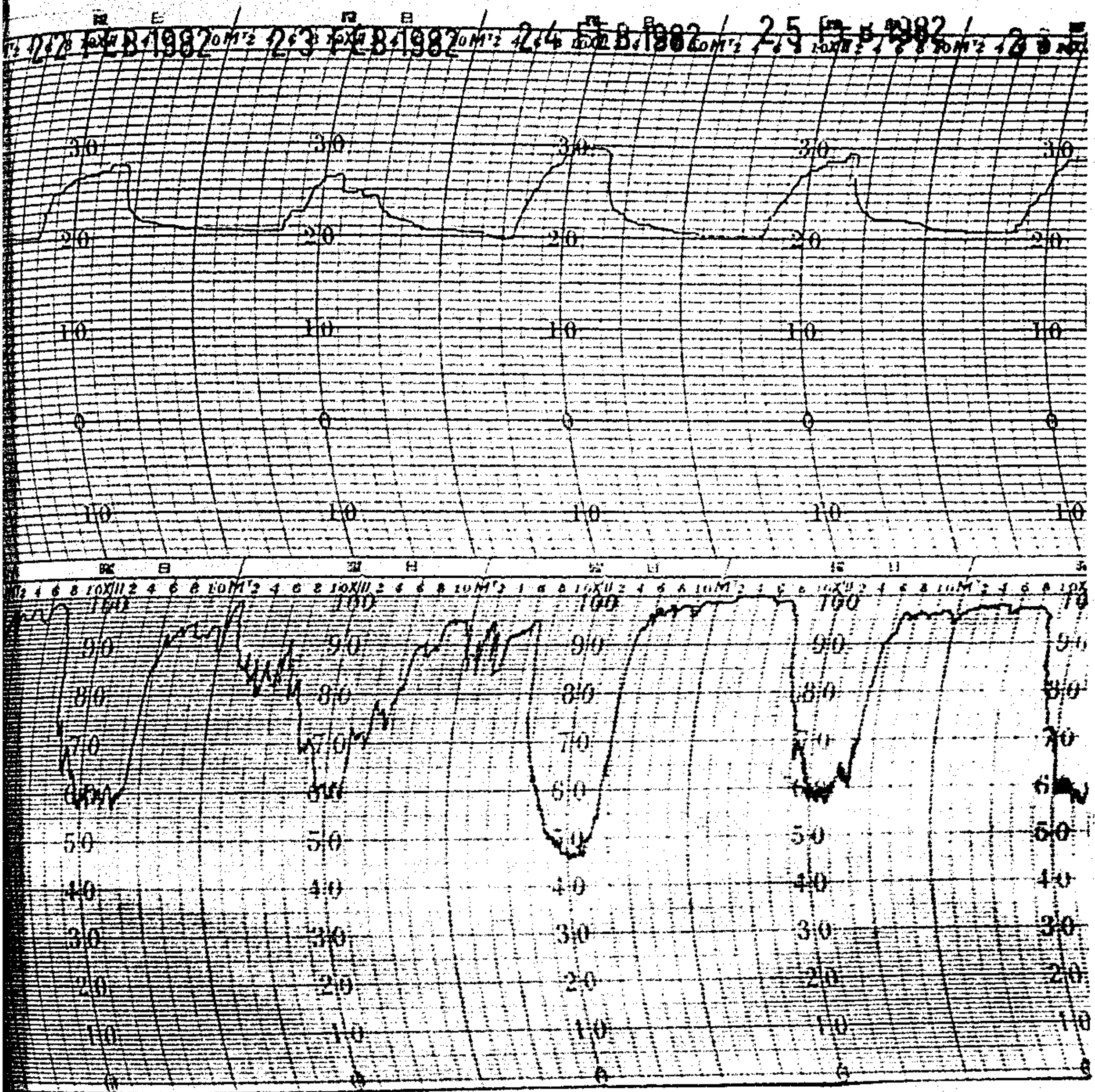
1) Maximum and minimum thermometer;
2) Dry and wet bulb thermometer;
3) Rainfall gage;
4) Self-registering rain gage (one-week type);
5) Anemograph (one-month);
6) Long recording thermo-hygrograph (one month); and
7) Mercury barometer.

Observation was carried out once a day at 9:00 a.m.; maximum temperature and precipitation are recorded as previous day's record because they happened the previous day usually.

Temperature : mean temperature throughout the year was 23.0°C. (An arthmetic temperature between maximum and minimum; whereas mean annual temperature at 9:00 a.m. shows 23.4°C.). From February 1, 1981 hitherto, the highest record of maximum temperature has been 31.2°C. and the lowest minimum temperature was 14.0°C. Mean maximum temperature was 27.7°C. and mean minimum temperature was 18.3°C.

Meanwhile; the following thermo-hygrograph chart shows the correlation between temperature and relative humidity. The diurnal change of temperature is as follows : temperature drops around 6 - 7 a.m. and rises to its peak around 12 - 2 p.m., whereafter it drops until sunset, and keeps cool until the next morning. In contrast to this, the relative humidity reacts as follows : the air is driest in the day-time, at a relative humidity of around 50 - 60% from 12 to 2 p.m. As the temperature falls, relative humidity rises in the evening it reaches 90 - 100 % and continues until next dawn.

CHART 1 THERMO - HYGROGRAPH



This pattern of diurnal change in thermo-hygrograph was repeated throughout the year. However, it sometimes rains in the daytime, with a relative humidity reaching 90 - 95%, and it affects the pattern of thermo-hygrograph. As the diurnal range of the termometer is very high between day and night, the relative humidity reaches 100% at night, and then the water vapor of the atmosphere is nearly saturated at night. This frequently causes foggy weather in the morning. Owing to this foggy weather, plants can take moisture even during the dry season.

Precipitation : As far as rainfall is concerned, much attention should be paid to the observation of annual rainfall fluctuation for long years. In order to decide the suitable timing for seedling transplantation its tendency should be studied, and in order to judge the adaptability of various tree species to the planting site, data of mean annual precipitation and rainfall fluctuation should be obtained.

As mentioned above, we have two stations; the one at the Training Center lies 1 km. to the east of the one at the Desa Chief's house. The following table shows monthly precipitation for the same period (February 1, 1981 to January 31, 1982).

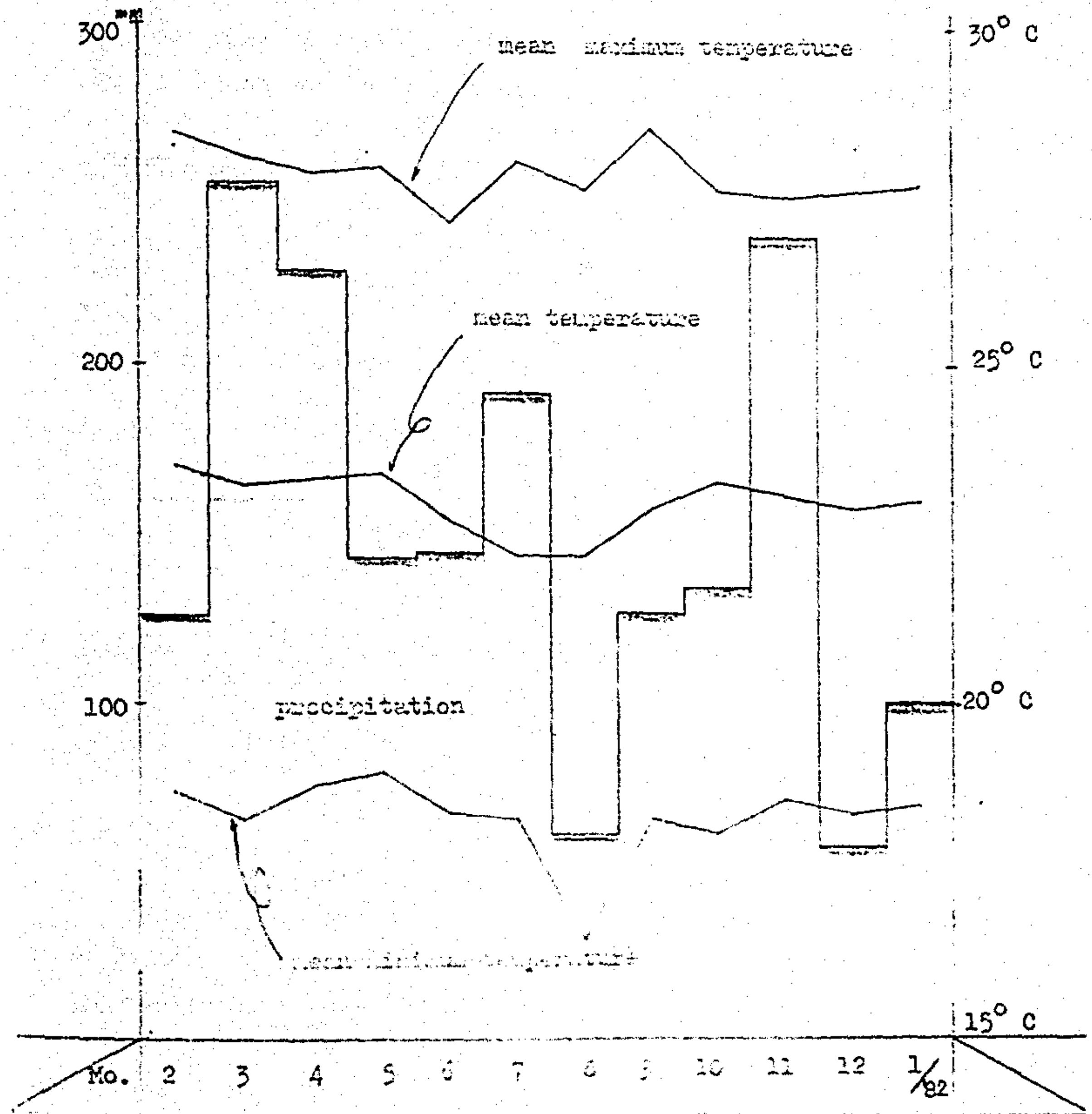
Table 14. Monthly precipitation and rain days at T.C. site and others.

	T.C 1/		Desa chief's 2/		Belajen 3/	
Month	Precipitation-mm		(Rain days)			
Feb. 81	126.2 mm	(14)	120.1 mm	(12)	83 mm	(10)
Mar	253.7	(20)	304.3	(18)	120	(12)
Apr.	227.2	(20)	233.8	(16)	190	(17)
May	143.0	(16)	162.6	(13)	151	(14)
June	144.5	(18)	147.2	(15)	86	(9)
July	191.8	(22)	189.5	(14)	137	(14)
Aug.	61.7	(5)	89.9	(4)	64	(4)
Sep.	127.3	(17)	146.3	(12)	105	(11)
Ock.	134.6	(20)	228.5	(15)	41	(7)
Nov.	238.1	(23)	265.1	(19)	124	(20)
Dec.	57.9	(13)	62.7	(9)	82	(13)
Jan. 82	104.2	(15)	79.9	(9)	103	(15)
Total	1.810.2	(203)	2.029.9	(156)	1.286	(146)

1/ About 900 m above sea level.
2/ " 850 m " "
3/ " 710 m a.s.l. (Agricultural Extension Service of Kab. Enrekang)

It can be said that microclimate in this area is highly variable. The following diagram, Fig. 1 shows the monthly mean temperature, mean maximum temperature, mean minimum temperature, and monthly precipitation to look in the correlation between temperature change and precipitation fluctuation.

Fig. 1 Monthly precipitation and temperature.



There is much rain in March, April, June and November. March and April, it is the season of the west monsoon which causes wet season in the western coastal part of South Sulawesi.

On the other hand, in November the monsoon from southeast which causes dry season over South Sulawesi becomes weak. It seems that there is much rain in this area while the monsoon changes its direction (West - Southeast, Southeast - West). Another point of view, the driest month, like August, the mean minimum temperature falls at the lowest point, 16.5°C. As the weather during this period is fine all day long, its radiant heat escapes high as there is no cloud which obstructs it at night.

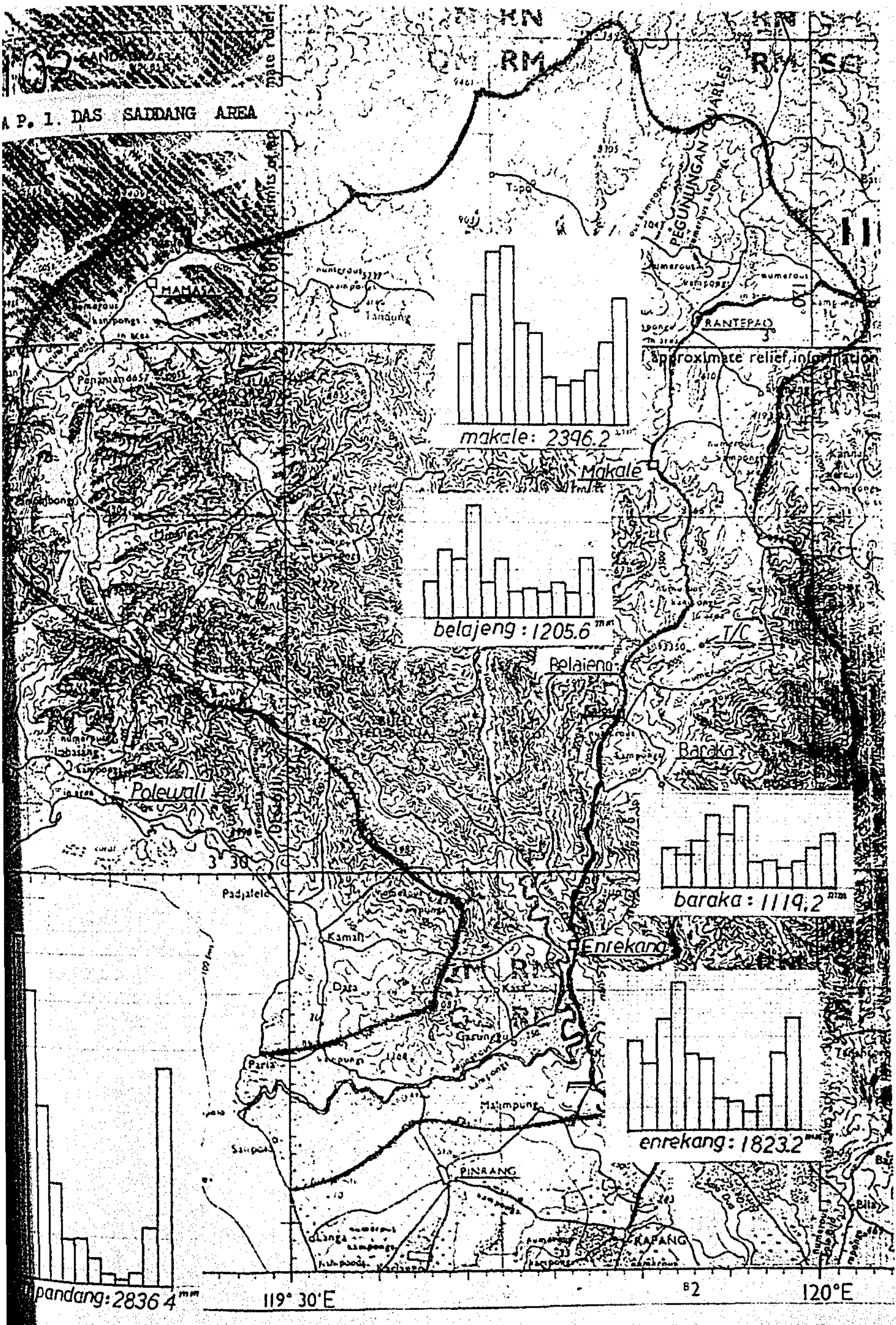
When rain days last long like in July, maximum temperature does not rise. However, monthly precipitation and rain days are very much like in March and April, the mean maximum temperature is still high.

It is because the rain usually drops at night, daytime weather recovers and the temperature rises.

Map 1 shows the location of meterological stations in DAS Saddang area and the histogram of mean monthly rainfall for the past 5 years. Stations are authorized and supervised by the Agricultural Extension Service except our station.

Enrekang	:	65 m a.s.l. located at about 50 km. inland from the coast. The difference between dry season and wet season is rather distinct than in other areas. 1823.2 mm
Baraka	:	510 m a.s.l. near the Latimojong mountain range. Precipitation is very scarce throughout the year. 11119.2 mm
Belajen	:	710 m. a.s.l. situated along the Mata Allo river. Also little rain throughout the year. 1205.6 mm
T. C.	:	900 m a.s.l. Average annual precipitation 1810 mm (provisional)
Makale	:	700 m a.s.l. situated in the southern part of Toraja Highland. Prefectural office of Tana Toraja. The town with much rainfall 2,396.2 mm.
U. Pandang* (For reference)	:	3 m a.s.l. situated in western coast line. Provincial office of South Sulawesi. It has definite dry and rainy season, and much rainfall; 2,836.4 mm.

A P. 1. DAS SADDANG AREA



Rainfall intensity : One of the most important rainfall characteristics is rainfall intensity, usually expressed in mm per hour. In general high intensity squalls last for fairly short periods and cover small areas, and do not occur frequently. These infrequent squalls cause much erosion damage and may result in devastating flood. So far our self-registering rain gage recorded the following high intensity rainfall (more than 40 mm / hour).

May, 4, 81	----	41 mm / hour
Nov. 1, 81	----	48.5 mm / hour
Nov. 2, 81	----	45 mm / hour
Feb. 1, 82	----	45.0 mm / hour

Wind : It is newly equipped and starts recording from February 12, '82 at the moment South wind is prevailing, and maximum wind speed is around 8 - 9 meter per second.

Atmospheric pressure : We started keeping record from July 1981. During survey period, the mercury barometer showed only a few fluctuations between 913 - 918 ^{mb}, and seemed to have no tendency. Atmospheric pressure ranging from 913 - 918 ^{mb} is at the altitude of 900 m. a.s.l. Then correction for sea level is needed. The formula is as follows,

$$h = 18{,}400\ (1 + 0.00367 \times t)\left(1 + \frac{h}{6{,}371{,}104}\right) \log \frac{H_o}{H}$$

h = Altitude of the site

t = average temperature between at heigh h and sea level in ^oC

H = Atmospheric pressure at the site

H_o = Atmospheric pressure at sea - level

$$\log \frac{H_o}{H} = 0.047956$$

$$\log H_o = \log H + 0.047956$$

if $H = 913^{mb}$

$\log H_o = 3.0084$

$H_o = 1019^{mb}$

if $H = 918^{mb}$

$\log H_o = 3.0108$

$H_o = 1.025^{mb}$

So, atmospheric pressure at sea level varies from 1,019 to 1025^{mb}. The area is under the high atmospheric pressure area. And atmospheric pressure ranging 913 - 918 ^{mb} means that the density of air is 90% of atmospheric pressure at sea - level. (The oxygen content of the air is also 90% of that at sea-level).

In vew of the results of meteorological survey so far achieved the precipitation is sufficient for the growth. Furthermore there happened sometimes dewfalls before and after dawn. They might be included as water supply for the trees. And there seems to be no definite dry season.

But according to my experience in this Pilot Test site for two and half years, I felt that it was very dry area here almost all the year round. Since there are no forests in the surrounding areas, the precipitation is lost by surface stream and can not infiltrate to the ground, by evaporation also in the daytime.

Although we can not conclude the climate tendency here by the results of our meteorological observation for only two years, we could say the dry season might be from end of July to October and during the dry season is not suitable for planting out, but suitable for raising seedlings in the nursery. Wet season might be from February to June. And we guess the wind direction will play important role as for changing the season in this area.

III-4 Afforestation Pilot Test

III-4-1 Background and Operational Plan

(1). Background.

Since 1976 the ATA-140 South Sulawesi project (Regional Agricultural Development Planning in South Sulawesi) has been carried out with following schedule :

Phase I 18 month ; Provicial Level
- Survey and Analysis concerning agricultural development
- Review of the existing Regional Development Plan
- Drawing up of sector plans

Phase II 12 month ; Kabupaten Level
- Drawing up of the implementation plans including project preparation
- Feasibility study for agricultural development project in specific Kabupaten-s i.e. Kab. Enrekang and Kab. Jeneponto

On the occasion of Steering Committee held in 1978, the Bupati of Enrekang proposed to the Team to consider the following items during phase II :

- The measure to increase agricultural products
- Preparation of road net work to smoothen communication
- Promotion of Afforestation and Reforestation

The Kabupaten authorities laid their hope on afforestation and grassland improvement as one of the development programs. Among 23 Kabupaten-s in South Sulawesi, Kab. Enrekang is backward in afforestation and reforestation project. To show good result in this project bring the effect on protection of erosion, land and water conservation and producing the forest products also.

And due to lack of fundamental technical data concerning forestry and grassland improvement in Kab. Enrekang, feasibility study was not yet completed during phase II. So phase III was set up to tackle with technical matters with two years' prolongation of the ATA-140 in June 1979. The following original plan of operation was approved by both governments at the same time.

Original plan of operation

1) Scope of activities.

The feasibility study of Afforestation and Reforestation will be continued in Kabupaten Enrekang by using the precise data which will be obtained through the pilot test.

2) Transfer of Technology.

Through feasibility study including the pilot test, methodology of project formulation and planning techniques will be transferred to Indonesia counterparts.

3) Pilot Test.

With a view to supplementing the prefeasibility study made in Phase II, the pilot tests of Afforestation and Grassland Improvement in mountainous area will be implemented. The technical data obtained from this pilot test will be fed to the project planning aimed at national use of sloping land and soil conservation. The pilot test is to be utilized for technical training and demonstration purposes. After the termination of Japanese cooperation in two years, the Indonesian side herself will carry out this activity in order to complete the pilot test.

4) Contents of the Pilot Test.

a) Location : Kabupaten Enrekang, Kecamatan Alla, Desa Buntu Barana.

b) Activities :

- Selection of suitable kinds of trees;
- Research on the growth rate of trees;
- Determination of planting system of trees;
- Identification of suitable methods of nursing and silviculture;
- Demonstration and training for silviculture; and
- Others.

c) Necessary facilities :

- Nursery; and
- Trial forest.

(2) Present Operational Plan

1). Implementation Policy :

a) The pilot test is to be divided into two sectors, nursery and afforestation technique, which are to proceed simultaneously;
b) Planting operation will be made more systematic and survey of initial growth will be conducted;
c) In the future the test forest is to be led to a seed dtand;
d) Emphasis will be placed on the collection of various reference data.

2). N u r s e r y :

a) Establishment of the system in raising seedlings for major tree species;
b) Introduction of technique for raising seedlings by cutting;
c) Pot material and improvement in soil cultivation;
d) Measurement of the growth cycle of seedlings;
e) Technical training and extension.

3). Test Forest :

a) Site topology;
b) Selection of suitable species;
c) Establishment of planting technique concerning major tree species;
d) Guidance of planting technique;

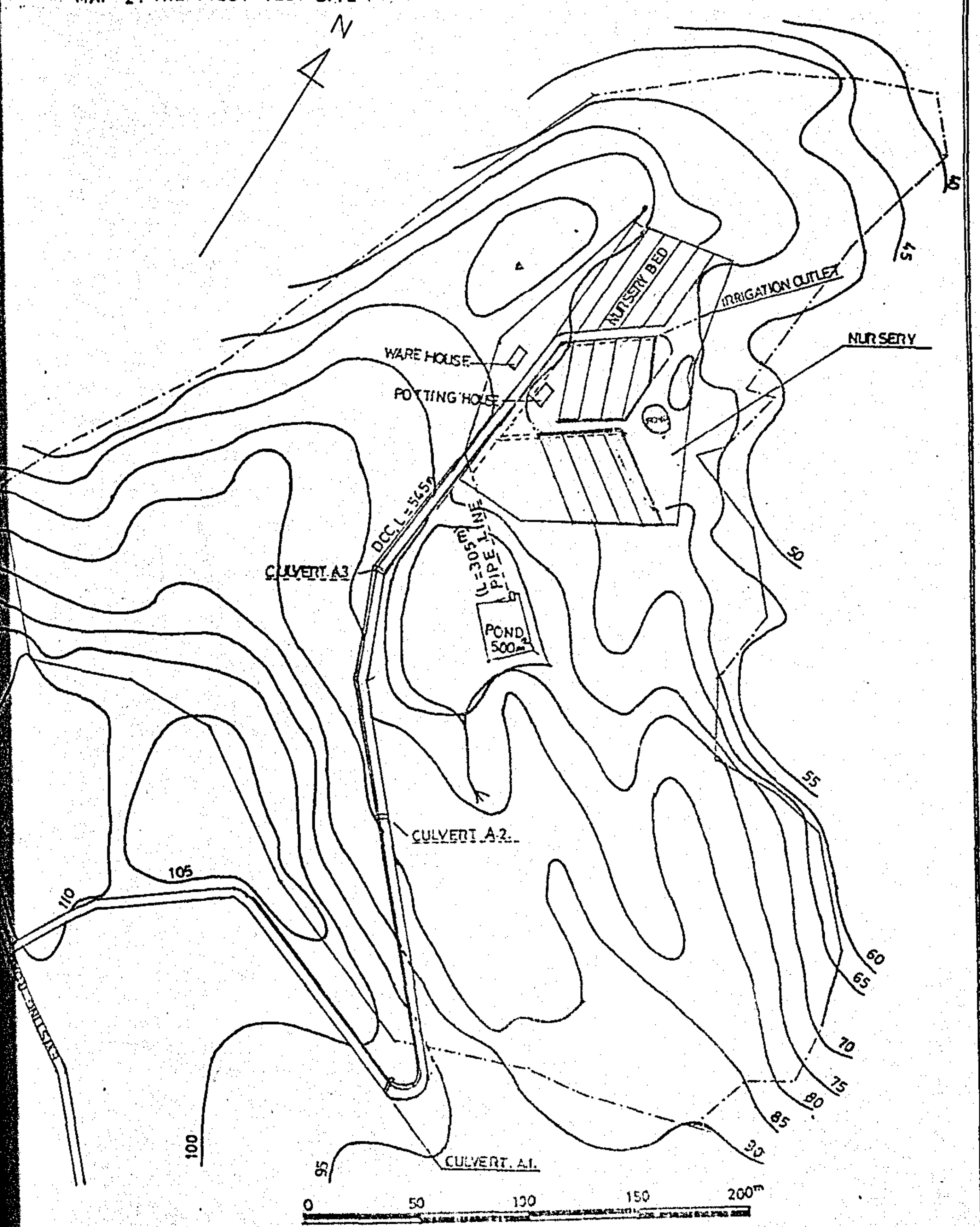
4). O t h e r s :

a) Meteorological survey;
b) Ecological study.

III-4-2 Nursery

The nursery area extends to 1.0 ha., and is located in the Pilot Test Trial Forest. Location is shown on Map 2. Topographic map of the Pilot Test Trial Forest

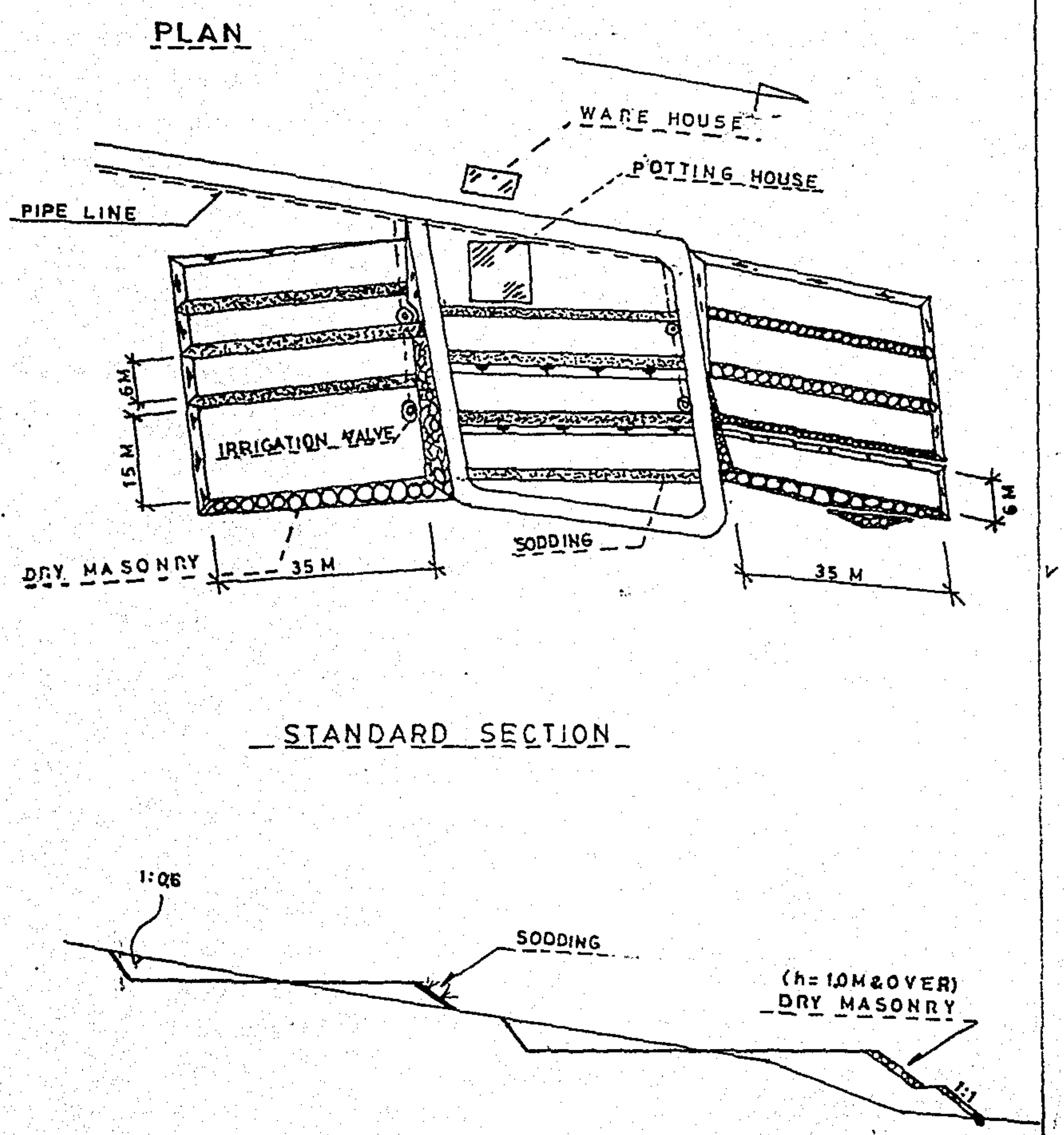
MAP 2: THE PILOT TEST SITE



(1) Construction of model infrastructure.

1) Model nursery was constructed at the gentle slope in the Pilot Test site. The plan and standard sectional view are shown in the drawing.

Drawing 1. The plan and standard sectional view of nursery



10 nursery terraces with	6 x 35 m	=	2,100 m^2
1 " terrace "	15 x 35 m	=	525 m^2
11 nursery terrace		=	2,625 m^2

One terrace was used as working field and potting house. So the effective nursery area covers 2,625 m^2. Irrigation pipe line was buried in the ground from the upper pump, and 4 riser couplers were constructed inside the nursery. Total length of pipe line is 305 m . The pipe is made of Polyvinyl chloride (p.v.c. pipe) with a diameter of 10 cm.

2) Intake facilities :

The pond was constructed with the area of 20 x 25 m = 500 m^2 and a surrounding bank of 0.5 m (effective hight is 0.2 m) high at the former natural pond.

Effective volume is 500 m^2 x 0.2 m = 100 m^3 .

The pump pit is 2.5 x 2.5 m wide and 1.4 m depth,

foundation was worked with mortal masonry.

Water storage capacity of the pump pit at 30 minutes pump Operation was calculated as follows :

Pump capacity at 30 minutes operation : v

$v = 0.1\ m^3$ minutes x 30 minutes $= 3.0\ m^3$

Effective water depth : h

h = 0.5 m (depth between the bottom of inflow course and foot valve)

Then, water storage capacity : V

$V = 2.5\ m \times 2.5\ m \times 0.5\ m$

$= 3.125\ m^3 > v\ (3.0\ m^3)$

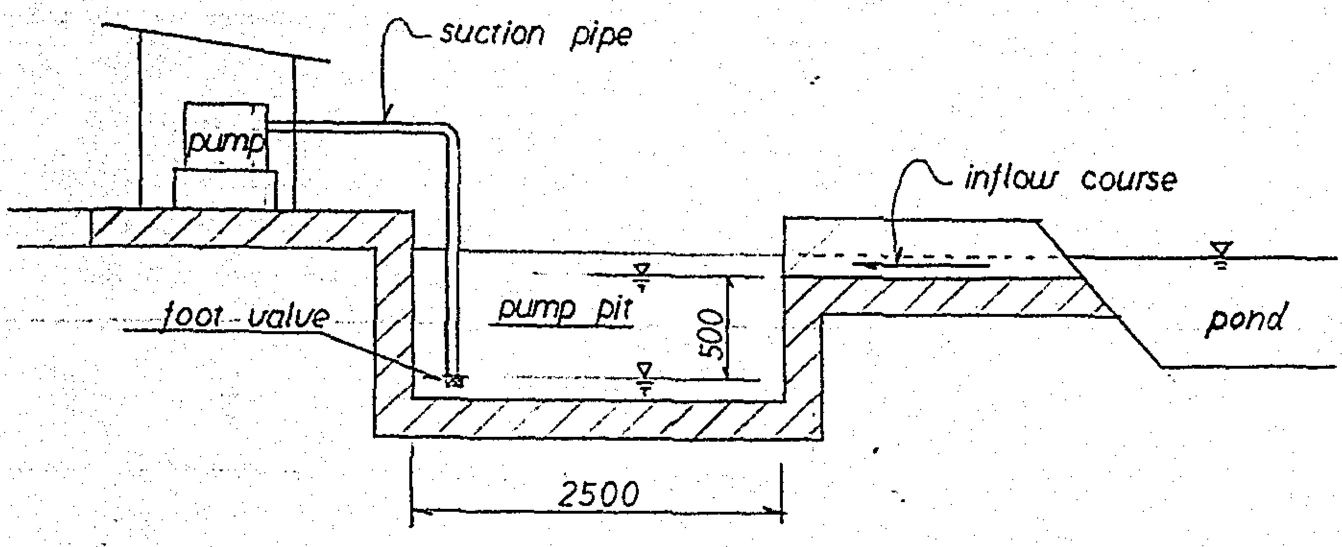
That is why the pump is good for a non-stop operation during 30 minutes.

The specification of the pump is as follows :

- Type	:	Centrifugal pump
- Quantity of water discharge	:	Q = 100 l /minute
- Pipe diameter	:	Ø 50 mm x Ø 40 mm
- Total lift	:	H = 40 m
- Rate of rotation	:	3.500 r.p.m./8 ps
- Engine	:	Diesel (maximum output 8 ps /2.200 r.p.m.)

Drawing 2. shows the sectional view of pump pit.

Drawing 2. The sectional view of pump pit



There are two types of irrigation facilities at the Pilot Test site

(1) Irrigation pipe, made of aluminum. Many small holes are already bored in the pipe so as to irrigate evenly on the nursery under water pressure

The extent of irrigation	:	12.3 m x pipe length
Pipe length	:	1 set = 32 m
Pressure	:	1.82 kg / cm^2
Capacity	:	99.1 l / minute
Intensity	:	10 mm / hour

(2) Sprinkler :

Type	:	general revolving
Sprinkling diameter	:	24 m
Pressure	:	2.1 - 3.2 kg / cm^2

(2) N U R S E R Y

In this period of Pilot Test activities, we had to establish the trial forest in order to get the data of growth rate and do some research works besides the improvement of nursery technique and many kinds of research works in the nursery. So it was a burden for us to improve the nursery techniques which needed " trial and error " sprit for some certain years and to carry out preparation works such as raising many kinds of seedlings for the trial forest at the same times.

In addition to that the delay in the construction of model infrastructure, limitation of budget and difficulty of getting seeds etc., disturbed Pilot Test activities. Consequently, we concentrated on raising seedlings for the trial forest; the species for which it was hard to obtain seeds, we collected wildings from the surrounding area and raised them in the nursery. As this was a trial to find out suitable species to these denuded area, we did our best to get and raised as much promising species in our nursery as possible. In Sulawesi there is not any seed orchard and reliable seed dealer. Therefore, some species were got through official routes,

- Lembaga Penelitian Hutan and Lembaga Penelitian Tanaman Industri in Bogor; Cengkeh, Rambutan, Duku, Jambu susu, Coklat, Enterolobium cyclocarpus, Intsia bijuga.
- Pusat Pengolahan Benih in Bandung ; Agathis lorantifolia, Swietenia macrophella.

And some were obtain through private routes

- International Timber Cooperation Indonesia, Balikpapan; Eucalyptus deglupta and Accacia magium.
- Trial Plantation Project Pantanbangan JICA, the Phillipines; Giant Ipil-ipil, Pinus caribaea and Albizia falcataria.
- Wilding; Casia siamea, Tectona grandis and Casuarina, Toona sureni
- Also some were obtained from road side; Swietenia macrophella and Pterocarpus indicus.

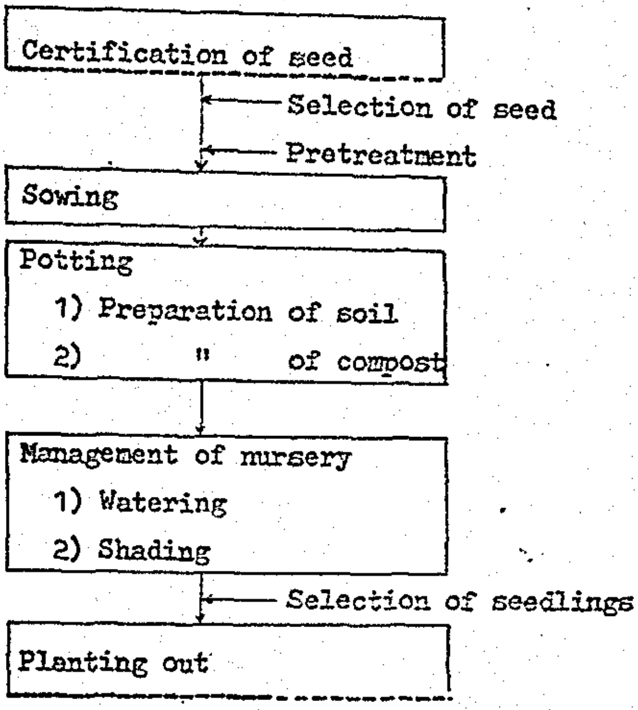
So far, we have tried 23 tree species. Scientific names Indonesian names, English names and the number of trees by groups are shown on Table 15.

Table 15. **Tree species raised in the nursery**

Species	Indonesian name	English name	Planted Month	No. of trees	Survival rate
A. Group : Horticulture or Fruits Tree					
1. Eugenia aromatica	Cengkeh	Clove	Oct '81	119	–
2. Nephelium lappaceum	Rambutan		–	–	–
3. Lansium domesticum JACQ	Duku		May '81	174	95.0
4. Psidium guayava LINN	Jambu susu		Jan '81	115	63.2
5. Theobroma cacao LINN	Coklat	Cacao	Feb '81	318	80.2
6. Cinnamomum sp.	Kayu manis	Cinnamon	Mar '81	299	–
7. Durio zibethinus	Durian	Durian	Feb '81	289	56.1
B. Group : Legumes for nitrogen - fixing					
8. Leucaena glauca	Lamtora	Giant Ipil-ipil	Dec '80	175	95.4
9. Albizia falcataria	Jenjung		Feb '81	320	97.5
10 Accasia magium			–	–	–
C. Group : Pine and rapid growing trees for industrial materials					
11 Pinus caribaea		Caribian pine	Dec '80	648	99.1
12 Anthocephalus cadamba	Kalampayang		–	3	–
13 Eucalyptus deglupta	Lada		Jan '81	93	86.9
14 Casuarina sumatrana	Cemara		Jan '82	147	70.1
15 Pinus merkusii	Tusam	Merkusii pine	Dec '80	757	98.9
D. Group : High quality and valuable lumber					
16 Enterolobium cyclocarpus			Dec '81	205	46.2
17 Intsia bijuga	Merbau		Jan '82	244	94.7
18 Casia siamea	Johar		–	445	76.2
19 Tectona grandis	Jati	Teak	Dec '80	198	97.5
20 Toona sureni	Suren		Jan '81	345	65.1
21 Swietenia macrophella	Mahoni	Mahogani	Jan '82	–	–
22 Pterocarpus indicus	Sono kembang		Feb '82	–	–
23 Agathis lorantifolia	Damar		–	–	–

a) Establishment of the seedling raising system for major tree species.

Raising seedlings in our nursery activities were practised according to following flow chart. And explanations on each point are described also.



Certification of seeds

It is said that the results of reforestation and afforestation depend mainly on good quality seeds. However, the qualitative analysis is only solved by establishing seed orchards in order to inherit a hereditary character. Seed certification thus means rather a quantitative analysis.

Seeds germinate on certain conditions, i.e. optimum temperature and humidity. If seeds are to be kept for a long time in viable conditions, their character is to be utilized in order to be stored. The significance is to keep seeds in best condition before they are sown on the nursery bed. The amount of seeds reliable to germinate is estimated by means of seed certification

Purity Rate $P = \frac{A - B}{A} \times 100$ (%)

where A = total weight of the specimen

B = weight of admixture (Immature & damaged seeds, fragment and sand etc.)

Germination rate $G = \frac{D}{C} \times 100$ (%)

C = the amount of specimen

D = the amount of germinated seed

In our activities, germination rate is not high enough. Leguminous species show a high germination rate, i.e. more than 90 %. Pine species shows that of around 80 %. On the other hand, Eucalyptus deglupta shows a rate of 60 %, but seeds from South Sulawesi are said to germinate for about 30 %. Anthocephalus cadamba has quite a low value. At first no seed germinated in the nursery, but several months later only tens of seed germinated; they are of quite small a size. It seems that the purity rate is quite low and the seeds are old.

No " Seed Law " has been established in Indonesia, so it is our obligation to take good care in managing and handling seeds by our own efforts.

Selection of seeds

Seeds may be judged from their apperance. Those which are incomplete, or abortive grain, should be eliminated.

Pre-treatment

Some seeds cannot germinate until they reach a certain condition. In order to promote seed germination, some treatment should be given a short time before the seeds are sown on the nursery bed.

1) Soak treatment : Keeping the seeds in water for one or two days; effective for Pine species.

2) Hot water treatment : Keeping the seeds in boiling water for 5 to 10 seconds, or in hot water for 1 - 2 minutes. Effective for Legume species; successful for Giant Ipil - ipil and Albizia falcataria.

When no pre-treatment is given, germination occurs unevenly, e.g. some germinate in one week, while some do not germinate before two months. Consequently, nursery management cannot correspond to transplanting on the field.

S o w i n g

After the selection and pre-treatment of seeds, they are sown on the nursery bed. A sowing bed is set in the nursery. In order to improve drainage capacity, the soil is mixed with sand by 50 %. If the soil does not drain well, seedlings may sometimes be effected by dumping-off. This dumping-off is a kind of disease affected the root and the lower part of the stem.

In case of small seeds like those of Eucalyptus deglupta and Anthocephalus cadamba, we had better prepare a small can with small holes at its bottom in order to sow evenly on the sowing bed. And it is necessary to cover the seeds with soil in 0.5 to 1 cm's depth. While seeds and seedlings are in the sowing bed, the biggest problem is dryness. To keep high humidity in the sowing bed, watering should be performed twice a day except on rainy days, and the sowing bed should be shaded to protect it from direct sunrays, employing a shading net.

Potting

In 2 - 4 weeks after germination, the seedlings will be trans - planted to the pot. The vinyl pot with tens of small holes was used in this nursery. When transplanting, we must take care not to damage the stem of the seedling, so we must hold the leaf of young seelinds if we take them out from the sowing bed.

Watering

As planting to the field should be carried out in the rainy season raising seedlings is done in the dry season. In order to keep the seedlings growing, we sometimes water the seedlings in the nursery. The necessary amount of water is explained through the following table.

Table 16. Coorelation between watering interval and watering depth

Soil	Watering depth 10 cm	20 cm	N o t e
Soil mixed with sand	6 - 10 mm	12 - 20 mm	3 - 5 days interval
S o i l	15 - 20 mm	30 - 40 mm	7 -10 days interval

Our watering system can sprinkle 10 mm per hour, then we operate the watering pump 30 minutes a day with two days interval (Considering our pot soil is mixed with manure and sand)

Shading

In this area, direct rays of the sun register about 100,000 luxes by handy illuminometer. The luminous intensity is too strong for the young seedlings during raising period, especially for the period after potting (because when the young seedlings are taken out from the sowing bed, the rootlets are broken).

So shading nets or attap are needed for a specific period, also shading materials are effective for protecting from dryness.

At present, we use a shading net (to be able to shade 25 % of the sun rays), in the nursery. But it is needed to get rid of the shading net before planting out in order to promote lignification of seedlings.

Selection of seedlings

To use sound seedlings for planting, we must choose good seedlings. The forky, dwarf or bending seedlings will be eliminated.

Planting out

Before planting out, planting holes are dug as big as possible because infiltration rate in this area is too small. (when it rains, rainfall amount usually runs off, with only a few prsent infiltrating into the soil see Table 13., page 97).

Timing of planting out is the next morning of the rainy day. The vinyl pot should be torn away.

III-4-3 Trial Forest

(1) Site Topology :

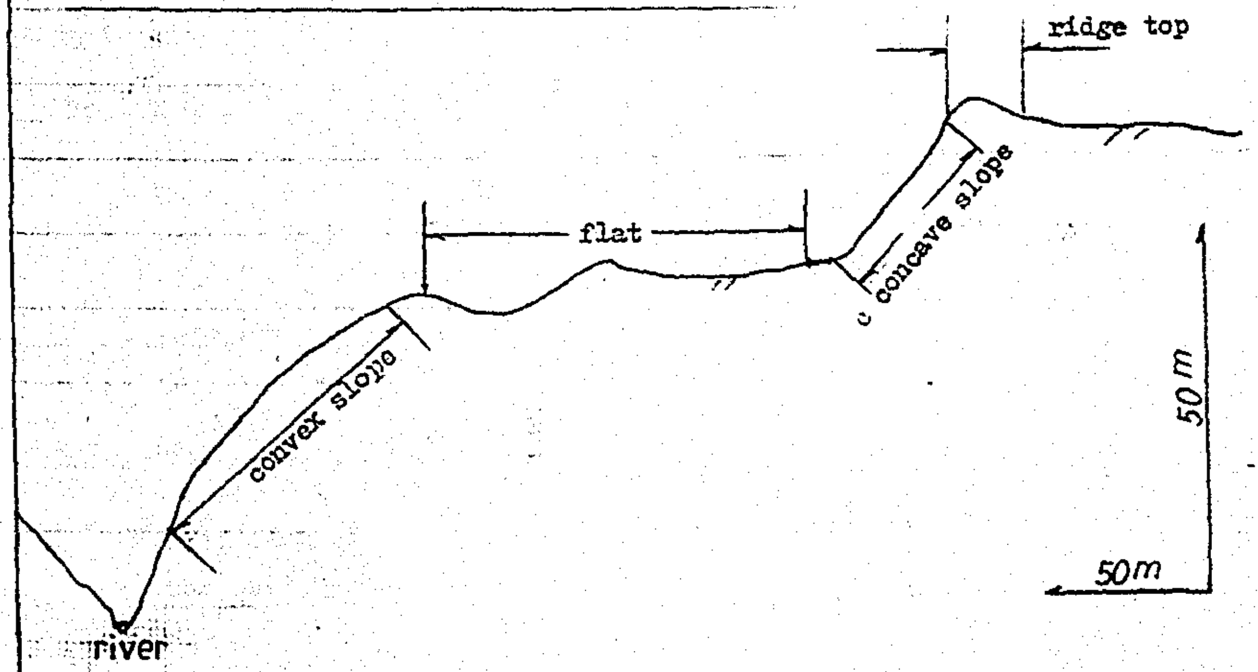
In Japan Akamatsu (Pinus densiflora) is planted on the ridge top, Hinoki (Chamarcyparis obtusa) on the slopes and Sugi (Cryptomeria japonica) at the bottom.

This planting practice based on site topology has long been established according to many experiences for hundreds of years and scientific verification. Though it is dry and not so fertile on the ridge top, Akamatsu grows fairly well. Sugi grow well at the bottom site with fertile and humid soil. While Hinoki shows good growth on poorer site condition than Sugi. The soil on the slope drains well. A principle of planting practice is : the right tree on the right site.

Site topology is to be conducted according to the difference in topography and the process of soil formation.

The trial forest area can be divided topographically into four sections; ridge top, flat, convex slope and concave slope.
Figure shows a typical sectional view of the trial forest area.

Drawing 3. Sectional view of trial forest



This topographic division roughly corresponds to the division based on the type of sedimentation, e.g. :

Ridge top and flat : elvium;
Concave slopes : colluvium;
Convex slopes : creeping.

Accordingly, with the topographic division it will be possible to obtain an appropriate reforestation policy for each site topology. And it may be applied to afforestation and reforestation of the surrounding forest land, based on the difference in suitable species and productivity.

The direction of our planting at present is from Southwest to Northeast, just the same as shown in the figure of Sectional View. Meanwhile data collection is undergoing.

(2) Selection of suitable species.

About 20 species have been planted for each division in site topology as mentioned above, and periodical mensuration of all tree species is carried out once in three months.

However, since it is impossible to ascertain the results of the planted trees in a short period, in the near future suitable species will be selected on the base of the results of evaluation.

Criteria for tree species evaluation vary with each other according to their purposes. The criteria for each group are described as follows:

A Group : Horticulture or Fruits Tree

The main criteria for evaluation are: fruit-bearing age, number of fruit and the taste of fruit, etc. But the ultimate evaluation will be made by examining the fruit quality. It usually takes 4 - 5 years to reach fruit-bearing age. So the evaluation will be made after the tree has borne fruit. But this species can be improved by horticultural method such as grafting.

B Group : Legumes for nitrogen - fixing

First of all the growth rate is surveyed, but ultimately, the condition of rhizomes is one of the criteria, as this species grasps the soil by its rhizomes.

C Group : Pine and rapid growing trees for industrial materials

: Growth rate, too, is one of the most important criteria. Nature of the tree trunk and chemical components such as the lenght of cellulose fibers and specific gravity are important items.

D Group : High quality and valuable lumber

Tree species under this group are usually slow-growing ones. Most important criterion is the physical feature of the wood, such as the durability of the timber, the ease in processing etc.

Explanations and comments for each species grown up in the trial forest are described as follows : The tree height and tree diameters of all the species were surveyed four times during our pilot test activities. Each time, we measured every line of tree specoes and one dot in the graph shows a average tree height and diameters of each line of tree. And, growth curve follows the average tree height and diameter of each species. Upper curve shows the tree height and the lower curve shows the tree diameter.

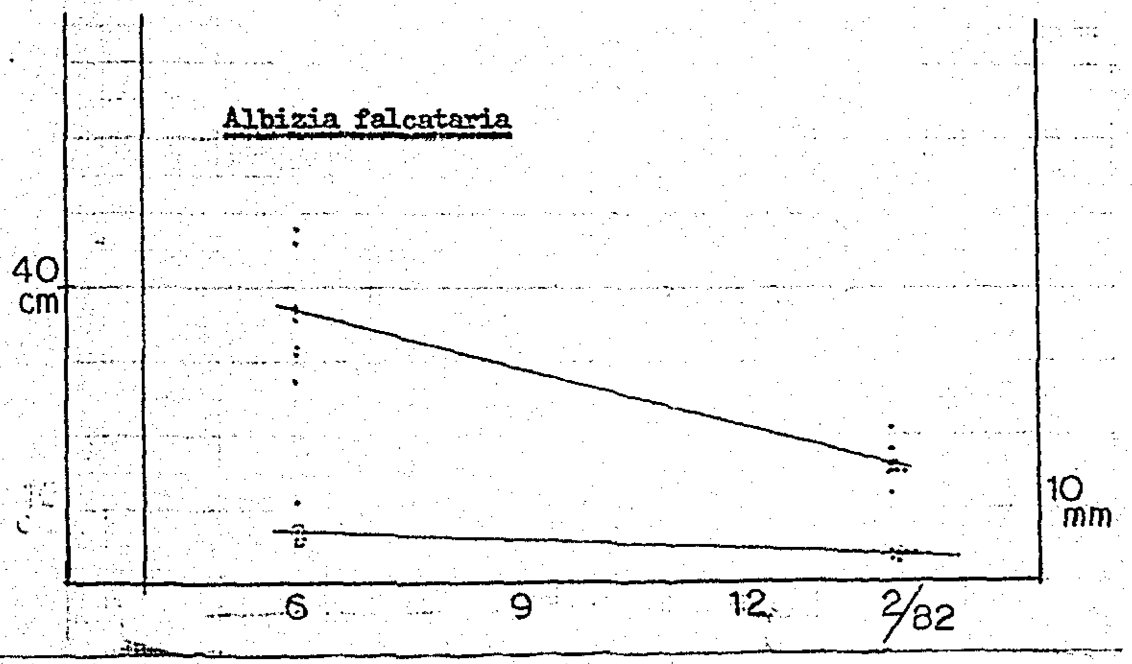
Albizia falcataria (Fam, Leguminosae):

Its distribution area is throughout tropical Asia, it is thought to be one of the fastest growing trees in the world; height of 18 m. at the age of three years and mean annual increment of 50 m^3/ha. have been reported.

Elevation ranging from 0 to 1.500 m. a.s.l., in fertile to moderate soils. The tree can grow up to 45 m. tall and has a diameter of over 100 cm. The trunk has not buttress, has smooth, light gray skin. Dry seeds amount to 40,000 per kg. and 36,000 per litter.

Specific gravity is around 0,33; the wood is used for plywood core, veneer and indoor construction. Also it is suitable for pulp and paper. This species are found around this area at the slopes to bottom site. At the coffee plantation, this species are used as a shading tree with its big crown.

In our trial forest, the growth is not so fast, but some trees near the roadside show a remarkable growth, i.e. 3 - 4 m. tall. It owes to the soil physical condition which has been improved by the model infrastructure construction. This could be promising species.



This graph shows minus growth. As many trees are died, a large number of refillment plantings were carried out before February'82.

Anthocephalus cadamba Miq. (Fam, Rubiaceae):

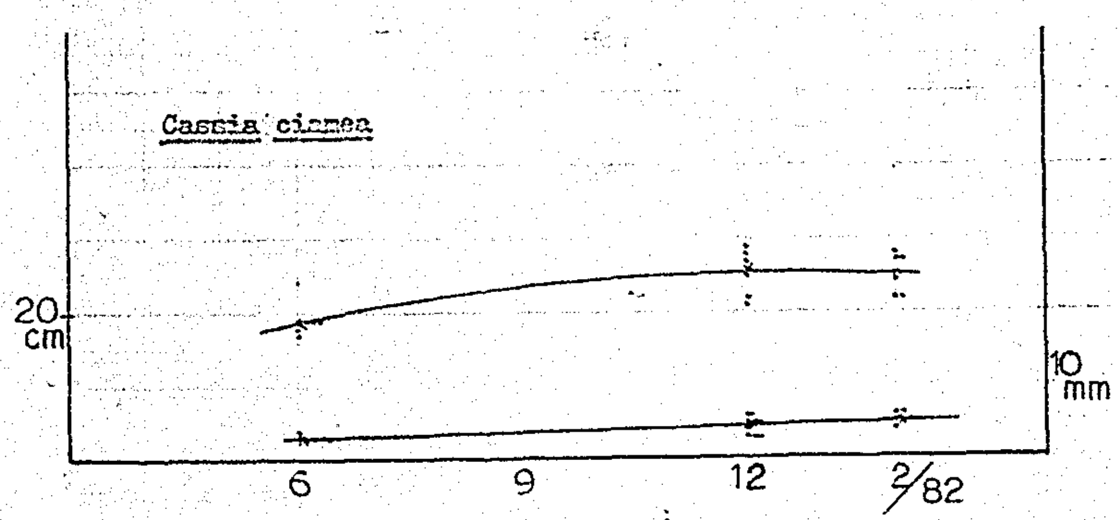
Found in the entire tropical Asia, hence in Indonesia, too. It is usually the first to occur in newly opened areas and in clearings where roads are being constructed or forests being developed; hence its being called pioneer tree. The tree can grow up to 45 m. tall, with 30 m. branchless trunk. Buttress is developed when the tree grows bigger. The fruit is as big as a table-tennis ball. The seed is very small, amounting to 6 million per kg. The wood is light, at a specific gravity of 0.42.

Seeds were obtained from the Phillipines; sown on the nursery, only few of them germinated, and it took quite a long time to germinate, presumably due to a poor seed quality. In our trial, only three was planted and is now already 3 to 4 meter tall.

<u>Cassia</u> <u>siamea</u> Lam (Fam, Leguminosea) :

It is distributed whole South and Southeast Asia and has planting experience for long time. Its timber is hard and specific gravity is ranging 0.8 to 1.2 with air-dry condition. The durability of timber is very good but its processing is not so easy.

This species which both planted and regenerated naturally are seen surrounding area with good growth. In our trial, the growth is not so fast but steady



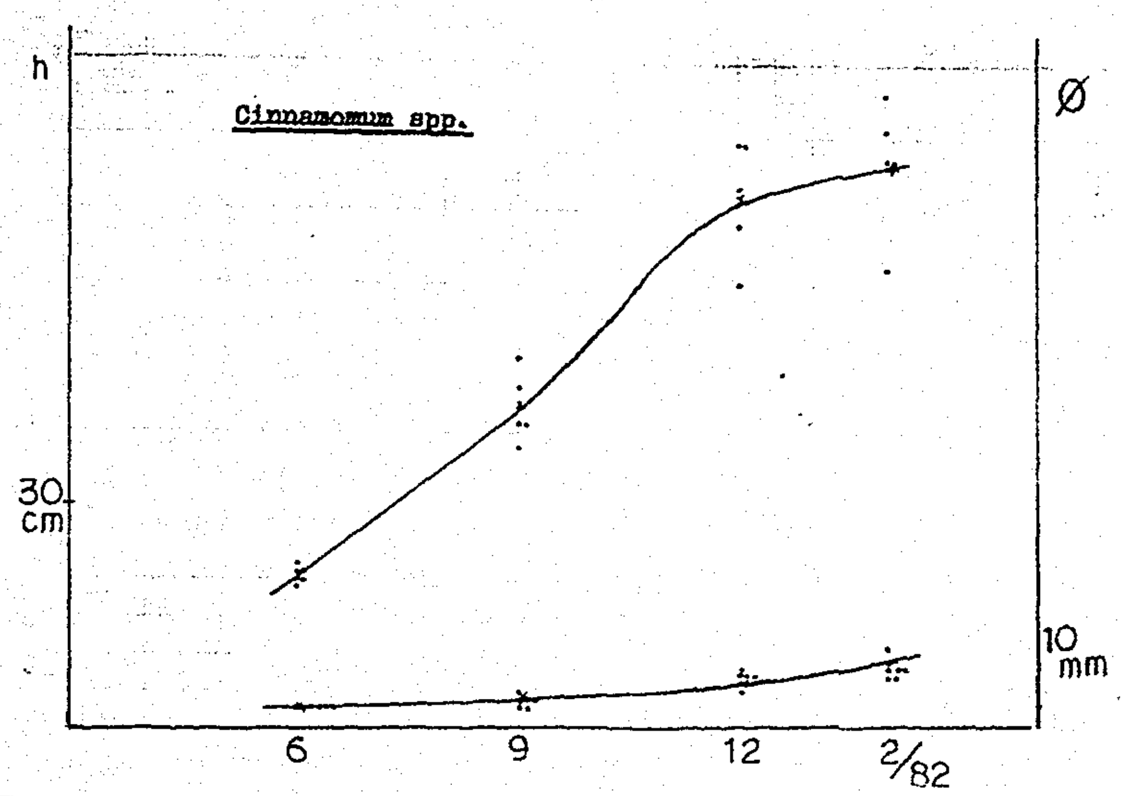
<u>Casuarina</u> <u>sumatrana</u> (Fam, Casuarinaceae):

It is native to Sumatera and Sulawesi, grows from lowland up to 1,500 m. a.s.l. in the mountainous area. In Tana Toraja, many are found sometimes forming a forest. The trunk is straight with less branches. The wood is heavy sometimes called "Iron Wood". The specific gravity varies from 0.85 to 1.10. We use wildings from the forest in Tana Toraja.

Cinnamomum spp. (Fam, Lauraceae):

Originated from Ceylon, but there are many kind of Cinnamon from the South-east Asia. Very famous as Cinnamon with its aromatic bark. The tree itself has sweet smelling but the bark is utilized.

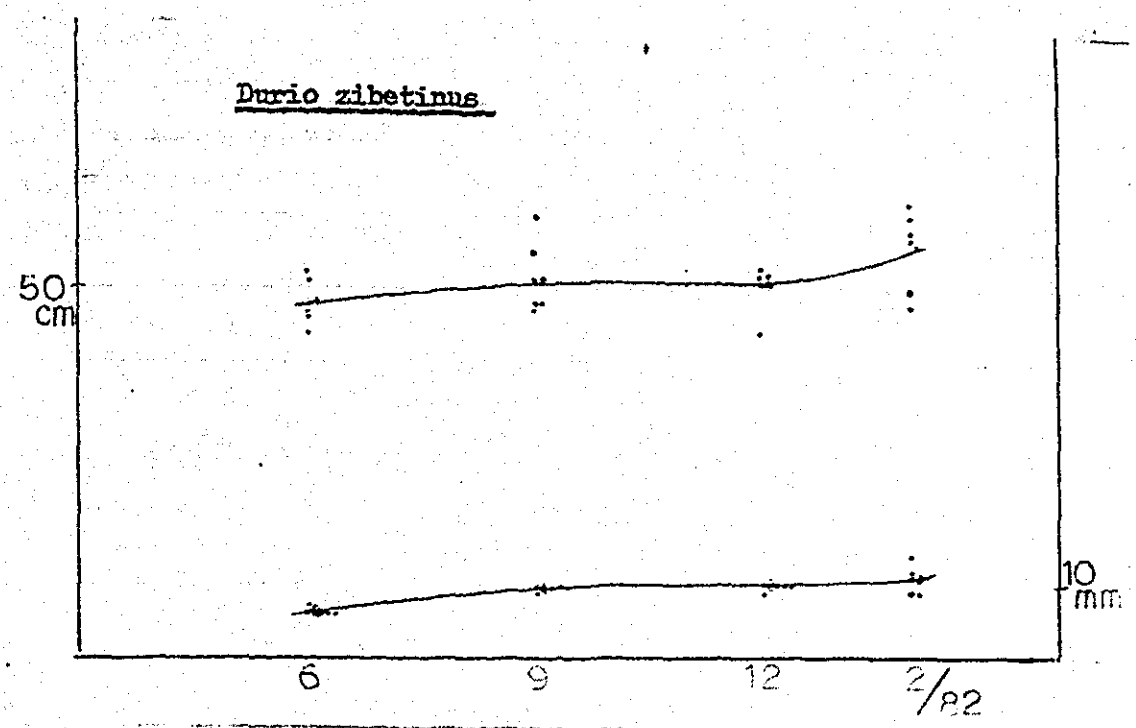
In our trial, the tree grows well and survival rate is high (this species seems to resist driness of the soil).



Durio zibethinus (Fam, Bombacaceae; Durian) :

Native to southern Burma, Thailand, the Phillipines, Malaysia and Indonesia. This species can grow at an altitude of 1,000 m. a.s.l., but it usually grows on lowlands or wet lands and on the lower parts of slopes. It may grow up to 20 - 30 m. tall; the trunk is usually straight. The fruit is called "the King of fruits". The tree will take 8 - 10 years to bear fruit for the first time, if it is grown from seedlings, and 5 - 6 years if it is raised from grafted seedlings.

Specific gravity varies from 0.55 to 0.77; the wood is used for construction and furniture. The growth here is not so bad but survival rate is not so high because of roots problem.



<u>Enterolobium cyclocarpum</u> (Fam, Leguminosae) :

This species is widespread throughout Central America from southern Mexico to northern South America. A large tree grows 20 - 30 m. tall with a stout trunk sometimes over 2 m. in diameter. In the forest it grows tall and long boled, but in open sites it forms a widespreading crown and makes a fine shade tree. This makes it ideal for use in parks, play-ground and along roadsides. The lumber is useful for furniture, paneling, construction and veneer. The tree in our trial forest shows rather good growth.

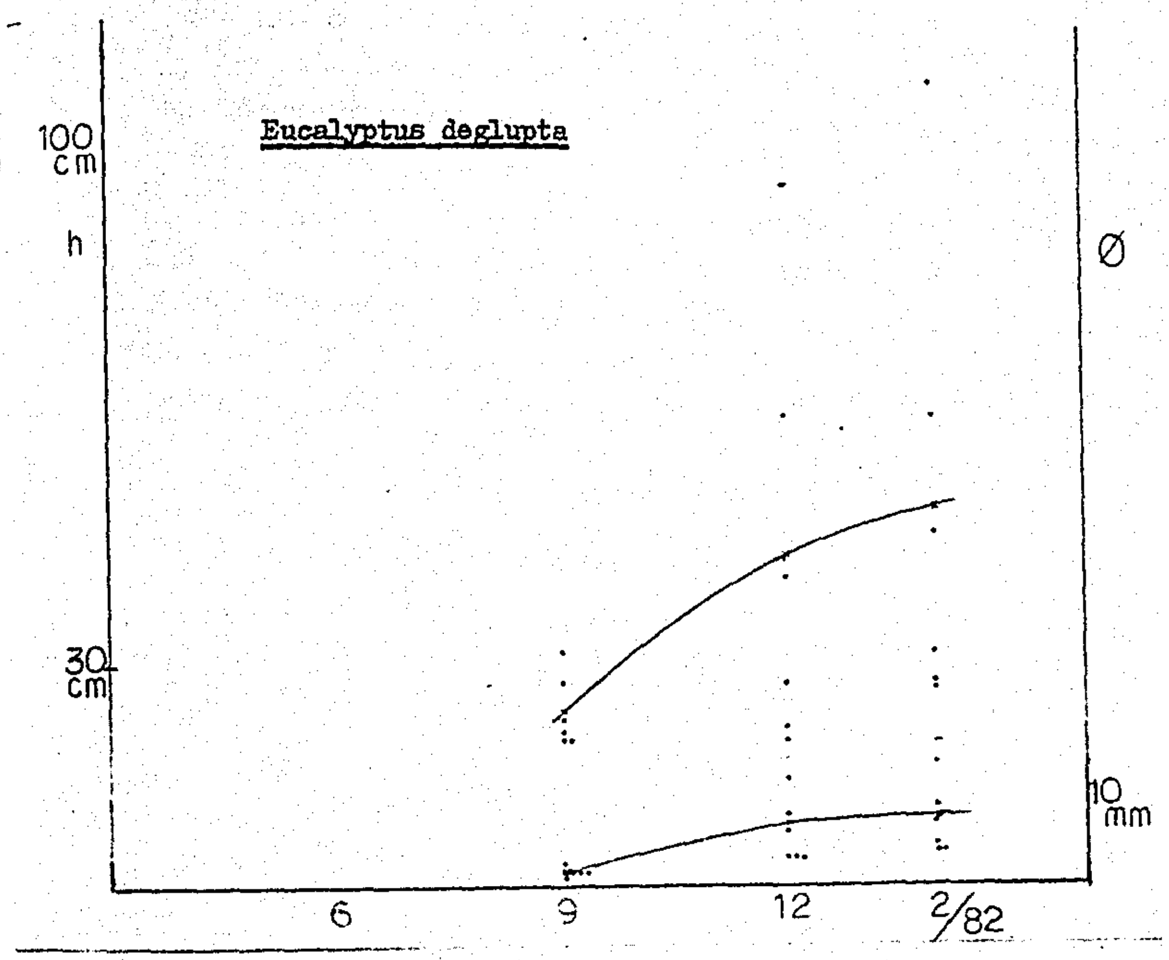
<u>Eucalyptus deglupta</u> B1 (Fam, Myrtaceae) :

It is native to the eastern parts of Indonesia which means east of Wallace's line, particularly in Sulawesi and Irian also the Phillipines. This is one of the few Eucalyptus species which occur outside Australia. In natural growth this species is found in sandy soils at the basin along the rivers or on slopes, generally at elevations of 0 to 1,000 m. a.s.l. It shows excellent growth in flat and low alluvial soils, which are flooded during the wet season.

The tree can grow up to 40 m. tall. It has very thin bark of a greenishwhite color. The tree flowers each year and bears fruits from young stage (from 1 - 2 years old). The seed is extraordinarily small, amounts to 11 million per kg. or 3.5 million per litter. The specific gravity of this species varies around 0.6 - 0.7. The wood has been used for poles and for pulp material.

We got seeds from ITCI in Balikpapan, and they showed better growth. But young leaves were eaten by insects. In South Sulawesi there are several mother trees in Pare-pare and etc. But quality is not so good, as it contains many impurity and germination rate is low.

In our trial, the tree grows well but growth rate among the lines varies widely.



<u>Intsia</u> <u>bijuga</u> (Fam, Leguminoceae) :

Throughout Southeast Asia and islands of the southwest Pacific. They are large, broadcrowned trees, sometimes exceeding 40 m. in height and 1.5 m. in diameter. It grows on wet lowlands and is found in coastal area bordering mangrove swamps, rivers, or river floodplains.

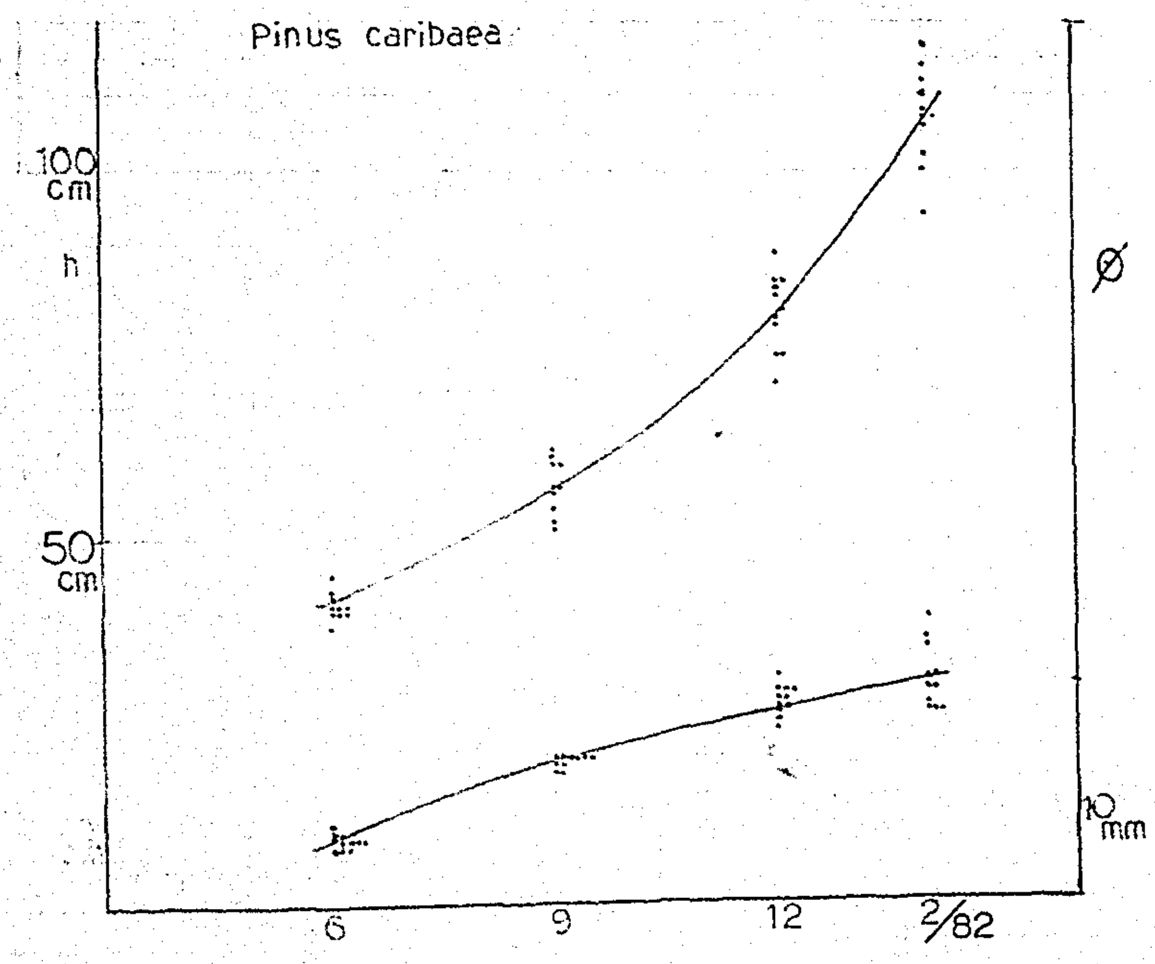
Average specific gravity is 0.65 and wood is resistant to the weather and to insect attack, making it useful for house posts. Its beautiful wood is appreciated in high quality paneling, furniture, decorative turnery. It is hard, stable timber that is also suitable for door and window frames and stairs. The seed is as big as a housebeen and amounts to only 200 per kg. In our plantation, seed are obtained from Bogor.

Pinus caribaea (Fam. Pinaceae) :

It originated in Central America, Honduras and Guatemala. Growing at elevations ranging from 0 to 1,000 m. a.s.l., it has become the most important lowland Conifer planted in tropical countries because of its ability to grow well and rapidly on poor, infertile sites, even at sea level on the equator.

The tree height may reach up to 25 - 30 m. ; leaves are three - needled,at 15 - 25 mm's length; but two or four needles leaves are sometimes found.

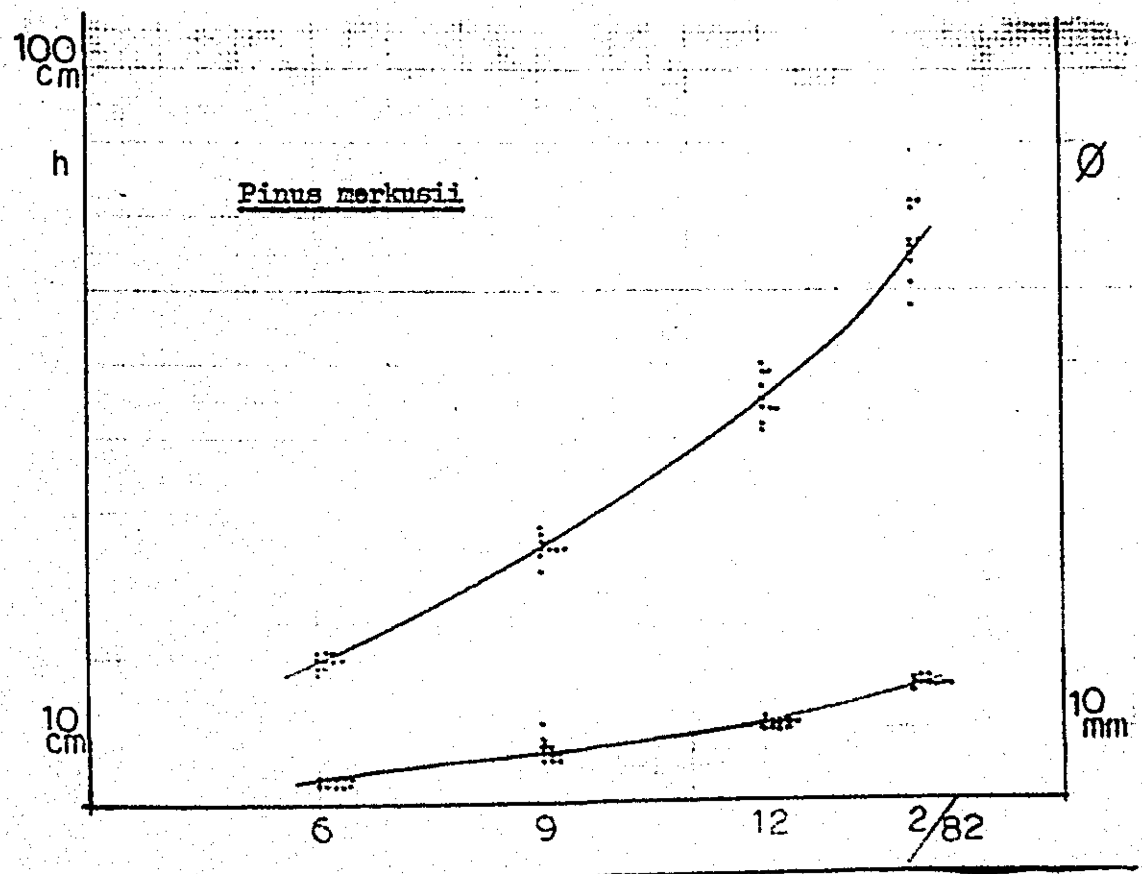
Seeds were got from the Phillipines; the growth rate is best among those in the trial forest, but nobody can guess how it will grow in the near future. There is no fox-tailing tree in the trial forest at present (In Malaysia, sometimes 30 or 40 % of the trees form a fox-tailing shape). Trees in our plantation are occasionally attacked by mice.



Pinus merkusii (Fam. Pinaceae) :

Only one pine species native to Indonesia. Besides in Indonesia, this species is found in Burma, Laos and Cambodia. In Indonesia it is much found growing naturally in North Sumatera and Aceh. Growing at elevations ranging between 200 and 2,000 m. a.s.l., it does not require a high qualification concerning habitat. Flourishes at elevations of over 400 m. a.s.l. Grows to a height of 40 - 45 m. Leaves are paired needles, and the fruit is cone shaped. The trunk is straight, and is seldom bent. The seeds amount to 50,000 - 60,000 per kg. in dry wingless form, or 29,000 a liter.

The wood is used for cases, match sticks and pulp, too, as Conifer have long fibers suitable for paper. Resin from this pine is sometimes used. In Saddang watershed area, many pine plantations have been made; in Tana Toraja it shows better result than in Enrekang, because of the abundant rain. The species grows rather slowly at its initial stage, as compared with Pinus caribaea. It grows steadily in the trial forest in spite of the poor soil. Seeds were obtained from the seed Processing Center in Bandung; locally obtained seeds contain many abortive grains, because the seed collector does not care about the seed quality and mother trees.



Swietenia macrophylla King (Fam, Meliaceae; Mahoni) :

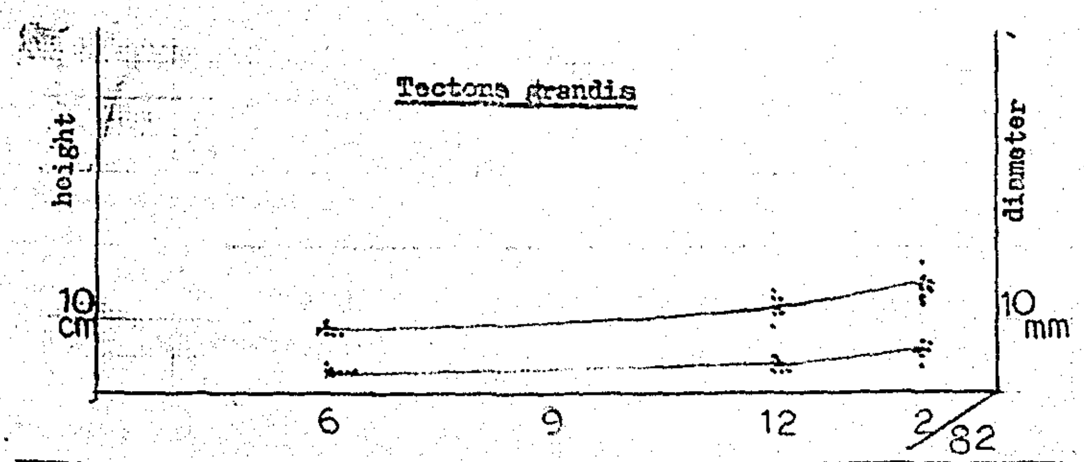
Mainly found in Central and South America. In Ujung Pandang this species is seen as ornamental trees along roadsides. It is widespread in Java but it was introduced from America. The tree can grow about 30 - 40 m. tall. The bark is grayish brown and scaley. It is deciduous during the dry season. The tree bears fruit as big as a softball, with plenty of winged seeds inside. Winged seeds amount to approximately 2,000 per kg. or 2,300 - 2,400 if wings are removed.

The wood is famous in the world for furniture. Seeds for the trial forest were obtained from the roadside trees in Ujung Pandang and from the Seed Processing Center in Bandung. It grows well but the soft leaves are eaten by insects, although the damage is not so serious. In the expert's experience while in Solomon Islands, and the Amazone in Brazil, this species was seriously damaged by bud-drilling worms and did not show a good result. This species is at present new to this area, so there is no symptom of the above-mentioned pest, but great care must be taken of it in the near future.

Tectona grandis LINN F. (Fam Verbenaceae; Jati) :

It is native to India, Burma, Thailand and Laos , and is also said to be native to Buton (Southeast Sulawesi). It grows in the monsoon climate zone, at elevations below 700 m. a.s.l.

The tree is ussually 25 - 30 m. tall, and can grow up to 50 m. with a diameter of 1.5 m. in better environmental condition. The trunk is generally round, straight with light gray, thin bark. It usually has no buttress. The seeds amount to 1,200 per kg. and 200 - 300 per liter. The wood has an average specific gravity of 0.55-0.77 with air dry condition. It has been used for furniture, construction, ships etc. In the trial forest the wildings were obtained near Kalosi. The tree grows rather slowly.



Toona sureni (Fam, Meliaceae; suren) :

Common in Indonesia and Papua New Guinea. The tree grows repidly, usually up to 40 m. tall. The trunk is straight, having gray bark. In Indonesia this species is planted along roadsides, at elevations below 1,500 m. a.s.l.

With a specific gravity around 0.4, the wood is light, soft but it is easily processed, used for ship, wooden cases and also for construction purposes.

Many of this species are grown with good result near the Pilot Test Site, at altitudes from 500 to 1,000 m. a.s.l., utilized as construction wood.

Pterocarpus indicus (Fam, Leguminosea) :

It is native to India, Burma, Malaysia, the Phillipines and Indonesia. It grows on lowland in alluvial soil near the coast. Tree height is usually 25 - 35 m., with broad crowned, heavily branched tree shape. The specific gravity is 0.5 - 0.7 with air dry condition, wood is the choicest timber for furniture, cabinet work, paneling and flooring and is sometimes marketed under the name of rosewood.

In Ujung Pandang, there many big trees along roadside, with yellowish green flowers and fruit with rounded wings. We got seeds from road side trees in Ujung Pandang. The growth here is at medium rate.

Eugenia aromatica (Fam. Myrtaceae)

This species is orginated from Moluccas and has ever been cultivated around Moluccas islands and southern part of Mindanau,Philippines. But now, there are only three major producing cuntries namely Indonesia, Zanzibar and Madagaskar.

The tree height is usually 10 - 12 m. tall. It starts flowering from age of 3 - 4 years. The buds of tree before flowering are utilized as an aromatic ingredient for cigarette, and for medicine also.

In this area,almost all the area was planted with this species and grow very well. One of the main concerns is outbreaks of disease. Then it needs carefully observation.

III-5 Point at issue regarding the afforestation and reforestation Project.

III-5-1 Problem to be solved.

(1) Plant variety;

There are many afforestation and reforestation tree species recommended by the authorities concerned but in South Sulawesi there were not enough experiences to conclude the suitable tree varieties.

Each plant variety requires certain condition for growth, particularly those on climate, soil and elevation above the sea level, whereas microclimate in the area varies with locality and so do the soil type and the elevation.

When we estimate what kind of plant would suit a particular living environments, we have a result in the identification of the most suitable plant varieties for the particular site. But, it does not suit other locations with higher temperature and with different soil conditions.

(2) Seed provision;

There are not seed orchard and seed processing center in South Sulawesi. However seeds are obtainable from Java, seed quality, seed durability and adaptability to this area is not so reliable if takes long time for transporting and climate and soil conditions here is very different from Java. And to attain the large target of afforestation and reforestation it is necessary to obtain a large amount of seeds.

(3) Nursery location;

For a good nursery which can yield sound seedlings, a number of conditions are required, among other things: sufficient water all year round fertile soil, close to the transplanting location. In critical lands among the mountains, however, it is difficult to obtain a nursery location which will meet most of the above-mentioned requirements particularly that concerning " sufficient water all year round ", which is very hard to find in the vicinity of the transplanting area. Consequently many nursery beds for afforestation and reforestation are either established at a far distance from the transplanting area or in the vicinity of the area but with the probability of encountering drought during the dry season.

(4) Communication means and supervision;

This problem yields a significant inhibition also in afforestation and reforestation, both for the seedling conveyance and logistics, as well as for the supervision by staff.

The locations of afforestation and reforestation in the area generally lie at a distance which will take 1 to 3 days' walk from the main vehicle road, across a rough field. A more advanced communication system is required for the solution of this problem, in order to get a quick and exact report on the progress of work at the far-off places and the way of rendering a quick treatment to disease-invaded plants or other logistic needs, particularly the transportation of seeds and seedlings.

(5) Disturbances by livestock;

In the DAS Saddang where livestock is still raised the primitive way, i.e. turned loose on the fields, it is extremely cumbersome to safeguard the afforestation and reforestation plants extending hundreds of thousand ha. within the area. Hedging is impossible, while keeping livestock in stables seems difficult for the local people to do. This problem requires an appropriate solution.

(6) Irregular climate;

Since afforestation and reforestation plants depend on rain water climatic changes constitute significant hindrances as well, while this problem is hard to solve.

(7) Shortage of skilled labour;

The labours don't care about the results of reforestation and afforestation because they don't know the meanings and significance of activities. The low survival rate are usually caused by performers indifference and ignorance toward the planting activities.

(8) Land-holding and land use plan;

The afforestation lands in this area are in general public lands, so the people who work on the planting on wage basis would feel lees concerned about the plants they work on because they know they don't possess them. Consequently the problems of maintenance safeguarding have not been solved yet. Furthermore, the land-use plan for these area has not yet been established so far, though the afforestation and reforestation plan should follow the land-use plan.

(9) Lack of maps and fundamental data.

The topographic map of this Saddang watershed area are insufficient. At present, the basic topographic map is still publications during the Dutch occupation at a scale of 1 : 125,000.

Even that was incomplete because the area to the north of 3° Southern latitude had no topographic maps yet.

III-5-2 COUNTERMEASURE TO BE CONSIDERED

(1) Plant varieties :

To decide the suitable tree species is very important subject and this pilot test activities are one of the adaptablities trials. Prior to select the tree species, its economical aspect should be considered from the viewpoint of utilization. And after selection of several species, further investigation for technical aspects are needed.

Technical aspects are the relationship between the tree growth and the productivities of land such as physical factor of soil, chemical factor of soil and the climatic factors etc. The basic principle is " Right tree on the right site ".

In order to solve this problem, this kind of pilot test activeties should be implemented at several places in response to the difference of physical factor. As for the Saddang watershed area at least 4 to 5 plots are needed and this kind of fundamental trial should be implemented.

(2) Seed Provision :

In order to improve the quality of tree and fruits, good seeds must be used. And some seed can be stored longtime as viable condition, although some are viable only for 2 - 3 days in natural condition. But some seeds can live long by controlling the physical factors such as temperature and humidity. It is necessary to know the physical feature in order to store seeds in viable condition in response to its character of seed.

And it is necessary to establish the seed orchard and seed processing center in order to improve storage technique and carry out selection of good tree species.

(3) Nursery location :

In this area a kind of shifting nursery was adopted. If construction cost of nursery is not so expensive and it is easy to find sufficient water in the vicinity of trasplanting area, it is possible to move the site of nursery by year. But the fixed nursery is ideal from the view point of management the nursery. It is better to fulfill the equipment, such as watering system and other incidental equipment, and to construct more large scale nursery, for example one or two nursery for each Desa, and distribute the seedlings to the planting site.

(4) Communication means and supervision

Construction of road network contribute not only afforestation and reforestation activities but also sosial economy. Road net work is shown by road density (Total lenght of road ÷ total area of forest m ha.) In Japan forest road density showed 10.3 km/ha (all weather public road is 6.7 m ha., and forest road 3.6 m /ha. In the area of DAS Saddang, it showed only about 1 m /ha.).

So the provision of good road network is recommended. Installation of the radiotelephone service is one of the solution for the management and supervision of nursery from the head office.

(5) Disturbance by livestock

The leaves of trees are eaten and the trees are downrodden by cattles. Above mentioned incident are the papular damages for afforestation and reforestation caused by cattle in this area. In order to solve this problem, the authorities concerned should formulate the Land-use-plan based on the topographic map with scale 1 50.000. In this land-use-plan, forestry play a very important role as water retention effect.

However only by formulating this land use plan, the problem is not yet solved if the people in the area did not understand the plan and the afforestation and reforestation activities. Then, it is necessary to provide the education and extention services to the staff concerned and also to the farmers.

(6) Irregular climate

It is said that in this area, the climate is very irregular, but it is not verified yet by scientific method. Establishment of meteorological observation net work is indispensable for this area to study the climatic tendency. For that purpose, meteorological observation should be continued for long time as one of out activities.

Another way is to device the organic pot material which can be planted together with seedlings. The seedlings will resist the driness.

(7) Shortage of skilled labour

This problem may have been solved by on-the-spot training for the workers and participants in afforestation. A model garden is in fact needed, but it would preferably be established in

(8) Land-holdings and land-use plan

People's land-holding status in these area is Right for utilization. After the enforcement of the Agrarian Law No.5 of 1961. the right has been transferred to the state of Republic Indonesia but the right for use remains on the part of the people, being the open possability to alter the right for use into proprietary right (Paddy field and housing site are generally regarded as proprietary right).

Plenty of uncultivated lands are found in this area and there has not been any plan for their allotment. These were regarded as free public lands, and may be cultivated by anybody. The cultivation would automatically acquire a right for use, but after 3 successive years, if abandoned, the right would be automatocally invalid.

To promote afforestation and reforestation, incentive measures such as governmental subsidies, long-term loans with low interest, tax credit etc. should be adopted, and also profit sharing system will be considered.

As for the land-use plan, the following matters is worth due consideration as to forestry concerned.

- Allotment of protection forest zone with 100 meter wide both sides of the river for watershed management forest
- Allotment of protection forest area on the ridge and steep slopes for the river head protection forest.

These area must be added to the forest territory and should be reforested as soon as possible.

As for the outside forest territory area, Agro-Forestry technique must be studied aiming harmonized development of rural economy.

(9) Lack of maps and fundamental data

Preparation of the Topographic map is the most urgent. At least, topographic map based on aerial photo with scale 1 : 50.000 is indispensable.

III-6 Operational Plan for the Afforestation Pilot Test in the Future

During two and half years of our pilot test activities, we have just achieved the layout of the pilot test comprising nursery, trial forest and meteorology station, and got started on measurement and research works within the frame work of Forestry Science which needs patient and persevering effort for longtime.

As for the nursery sector, since nursery facilities are equiped, improvement of silviculture technique and materials will be studied in succession.

As for the trial forest, miscellaneous tree species have already been planted in the area. Mensuration, measurement and research works are the main tasks in the trial forest, which will be lead to demonstration forest. The study for protection from disease and insect invasions will also be included.

III-6-1 N u r s e r y

(1). Establishment of the nursery techniques.

The ultimate task in the nursery is to raise vigorous seedlings within a fixed period. Since each species has its individual growth character, appropriate management will be adopted. The following items will thus be investigated upon :

- Shading ; control of the luminous intensity.
- Density control of the seedlings in the nursery bed.
- Timing for the transplanting to the pot.
- Pre-treatment of seeds.

Rationalization of the nursing process will also be studied.

(2). Introduction of cutting techniques in raising seedlings.

In regions outside Java, such as South Sulawesi, it is rather difficult to obtain seeds from the viewpoints of quantity and quality. This region being lagging behind in afforestation and reforestation, only few seeds are produced here.

However, cutting technique for the tree species is an unknown field in the tropical area. This technique will be tried in order to solve the above-mentioned problem in replacing seeds.

(3). Improvement of material.

A considerable amount of labor is required for the transportation of the potted seedlings to the planting site, and field workers can only carry a few potted seedlings if pot is too big and weighs very much.

If the pot is made of organic materials possible for soil formation, it will be extremely effective as it can be planted the way it is. Such organic meterials will be sought after.

(4). Measurement of the growth cycle of seedlings.

Tree species show different growth cycles depending on the difference in rainfall, sunshine and temperature. Consequently it has an important implication from the viewpoints of the timing of fertilizer application and prevention of various damages to ascertain the growth cycle of each species raised in this trial forest. It is therefore necessary to measure the growth rate in a particular period and to make the growth curve.

III-6-2 Trial Forest :

(1). Establishment of planting technique.

As regards planting technique, there are various technical elements to improve survival rate and to stimulate initial growth, such as form of the seedlings (potted seedlings, bare-root seedlings, cutting etc.) fertilizer application, effects of mulching, direct sowing, shelter effect, weed cutting etc.

(2). Measuration and measurement.

It takes at least 10 years to decide the suitable tree species. So periodical measurement according to site topology should be carried out continuously. Until the third-fourth years, measurement will be conducted 4 - 5 times a year, but afterwards it will be twice a year. If the tree height is below 1.2 meter, tree height and girth at the lower point of the stem should be measured and if it is over 1.2 meter, tree height and diameter at breast's height should be measured.

(3). Prevention of disease and insect invasion.

Grasslands have existed for a long time in these areas, so the ecosystem has long been established. But if the denuded grasslands are replaced by forests with the progress of planting activities, the existing ecosystem will also be transformed to a new stage.

It is supposed thet new harmful insects and new types of disease will appear, in response to the new ecosystem. The change of ecosystem should therefore be observed with care. In case an outbreak of damage were found it would be necessary to take appropriate countermeasures at the earliest time possible.

III-6-3 Supplementary Activities

(1). Meteorological Observation.

In order to find out the onset of rainy season, - the timing of planting out in the field -, it is necessary to survey the climatic tendency in the area. Continuation of meteorological observation over a long period is required, Consequently the following items will be observed continuously :

- Maximum and minimum temperature ;
- wet and dry bulb thermometer ;
- precipitation ; and
- wind direction and velocity.

(2). Seed orchard and Tree breeding.

A plantation site extending tens of thousand hectares is said to have been established, but plenty of crooked tree stems have been seen, It thus brings about a decline in economic value. In the future, it would be desirable that plus trees and plus forests be determined, and a seed orchard be established near the pilot test site. Then, seeds dhould be collected from excellent mother trees.

(3). Agro-Forestry.

Agro-forestry technique such as intercropping will be studied.

(4). Laboratory and Office.

As experimental facilities were provided by the Japanese Government, a laboratory and office should be constructed and utilized by staffs.

III-6-4 Equipment Utilization Plan

The Japanese Government has already given the following main equipments and vehicles for the purpose of afforestation /reforestation Pilot Test activities recommended by the forestry advisor. The Indonesia side is requested to utilized them fully and give them good maintenance.

1.	Bulldozer D53A-16	Mainly for training and for construction of road network, check dam and terraces.
2.	2-ton Truck	To carry seedlings for the planting site and to carry soil, fertilizer, etc. for the nursery
3.	Landcruiser (4WD) & Motorcycle	To supervice the activities and smoothen the communication between the offices concerned.
4.	Forklift	To change the attachment of bulldozer such as ripper and towing winch and also for loading and unloading to truck.
5.	Transit, Auto level Plane table	Mainly for training and making more precise topographical maps.
6.	Mirror steroscope	To analyze aerial photographs.
7.	Microscope with camera	Experimental instrument to analysis and identify disease etc.
8.	Microtome	Attachment to the Microscope.
9.	Chainsaw	To conduct the thinning and to collect wood specimen.
10	Windvane, Anemometer recorder, Rainfall recorder, Thermo-hygrograph recorder, Max-min tube thermometer	To record the meteorological observation in order to find out type and tendency of climate.
11	Soil hardness meter	To measure the soil hardness and check the physical character of soil.
12	Bushcutter	Weed cutting
13	Watering system with pump	Watering for the nursery.
14	Blume-Leiss	To measure the tree height.
15	Caliper	To measure the tree diameter.
16	Current meter	To measure the velocity of the river water.
17	Knapsak sprayer	To disinfect in order to protect from disease and insect.
18	Belt conveyer	For loading and unloading of soil, sand, gravel, etc.
19	Office equipments	Office use.

CHAPTER IV. GRASSLAND IMPROVEMENT PILOT TEST.

Fumiaki Harada
Osamu Suzuki *
L. Kala' Pong Masak **
M. Syata Sanusi **

Contents

* Short-term Expert for Grazing in charge of IV-3-6 Grazing Management of Bali Cattle

** Indonesian counterparts

CHAPTER IV. GRASSLAND IMPROVEMENT PILOT TEST

IV-1. Animal Husbandry and Grasslands in Indonesia and South Sulawesi

IV-1-1. Natural Environment and Grasslands :

A glance at the map of the Indonesian archipelago, with its widespread and scattered distribution of islands, will really embarrass us when we intend to put whatever comments on this vast territory. The high mountain chains of Sumatra stretch forward beside the Malay Peninsula toward Java, the most densely populated island in the world. There continues the stepping stone of Nusa Tenggara Islands, while the forest covered Kalimantan and the orchid shaped Sulawesi exist there on the north. Across the Maluku and Halmahera spice islands, Irian Jaya lies wild with its virgin forests.

The greatest distance of Indonesia from the east to the west stretches 5,100 km., which is approximately equal to the distance between Ireland and Turkey in Europe. Travelers will be surprised at the diversity among various regions that had been nurtured by their own natural environment and the long history of many ethnic groups. Since it seems quite exchausting to touch upon those different situation of each region, we now had better extract some uniformity out of the characteristics which all the regions have in common.

The Indonesian archipelago can be symbolized by the happy expression, " Emerald-colored islands floating on the tropical ocean ". Being situated in the equatorial latitudes, the prevailing climate is moist and tropical. The mean temperature of each island is around 27°C. throughout the year except where it is influenced by altitude. The north-west monsoon which brings the heaviest rainfall lasts from November to April; the south-east monsoon, from May to September. Favored with abundant rainfall amounting to over 2,000 mm. per year, tropical rain forest is generally the dominant vegetational type in Indonesia, while deciduous monsoon forests and fire-maintained grasslands are characteristic of the seasonally dry area.

It is rather difficult to define what a grassland is. From the viewpoint of animal husbandry, grasslands should be limited to those lands which are covered with forages for the purpose of grazing livestock. As a matter of fact, however, the other areas dominated by natural grasses are all classified as grasslands. Some of them might be savannah grasslands maintained by a markedly dry season or repeated grazing. Some others might be fire maintained alang-alang grasslands, abandoned upland fields, or denuded barren lands caused by shifting cultivation. The concept of grassland comprises all these areas where grasses of any kind grow, and can be utilized, in some ways, as a site for animal husbandry.

IV-1-2. Animal Husbandry in Indonesia :

Animal husbandry can only be carried out with the presence of farmers, livestock and forages. Considering that about 2/3 of the population consists of farmers, and most of the forages are procured within the limited scope of each region, it is worth analizing the distribution of these three elements mentioned above and the other factors concerned.

Although occupying more than half of the total area, Kalimantan, Maluku and Irian Jaya have little significance in both food crops and animal husbandry, which indicates that these areas with their deep rain forests still remain intact (Refer to Table 1). On the contrary, Java and Madura show a striking contrast to the other areas. This considerably smaller region surprisingly shares 52.3% of paddy fields, 62.5% of human population, 60.5% of cattle and 46.0% of water buffaloes, and 20.4% of horses.

The extreme grassland deficiency in Java, i.e. less than 0.02 ha. for each large livestock, implies that livestock farming in Java and Madura is carried out within the context of the traditional smallholder agricultural system. Being kept in ones or twos, livestock is generally managed almost as part of the family, and becoming very docile. Livestock is actually the smallholder's source of traction, manure, and a living " cash reserve " both as the means of savings and as the source of income on the special occasions.

The majority of cattle breed in Java is Ongole (Bos indicus) of the draft type Zebu, large framed, lightly fleshed but strong and hardy with a slow growth rate and low fertility; reasonably high final weight. Without spacious grasslands for livestock to be grazed free, cattle are normally penned and fed with forage collected and brought to them. Not only natural herbage but also agricultural by-products of all kinds edible for cattle are elaborately gathered and supplied by children and unemployed family members. The farming system in Java shows one of the typical examples of " multi-labor, less capital " smallholders' integrated traditional farm household. It is reported that in Java decreasing farm size is causing a shift from animal to human power in rice cultivation. Cattle are usually sold in times of drought or in time of need, or at the end of their useful life as draft animals. But once peasants dispose of their livestock for some necessity, they usually find difficulty in procuring the next ones due to lack of funds.

Supposing there is much similarity between Bali and Java in their way of animal husbandry management, Nusa Tenggara and Sulawesi are marked with their large livestock population as compared with their own human population. Reflecting the markedly dry season occuring in Nusa Tenggara, South and Southeast Sulawesi, these regions are rich in grasslands occupying more than half the total grassland area all over Indonesia. In these regions farming is carried on in more extensive ways than that in Java or Bali, and cattle herds are generally allowed to graze freely in the non-irrigated paddy fields and uplands in the dry season and are pastured in hilly grasslands in the wet season.

Table 1. Distribution of Land Utilization, Human and Livestock Popolation (1978).

Item / Region	Main-land	Paddy field	Grass-lands	Human Popul. x 1000 person	Livestock Population x 1000 head			
	x 1,000 ha.				Cattle	Buff.	Horse	Total
Sumatra	47,361 (24.7%)	1,634 (24.3%)	860 (30.6%)	25,302 (18.5%)	670 (10.4%)	506 (21.9%)	23 (3.7%)	1,199 (12.8%)
Java & Madura	13.219 (6.9%)	3,511 (52.3%)	88 (3.1%)	85,256 (62.5%)	3,883 (60.5%)	1,063 (46.0%)	125 (20.4%)	5,071 (54.2%)
Bali & Nusa Tenggara	8,849 (4.6%)	342 (5.1%)	758 (27.0%)	7,480 (5.5%)	915 (14.2%)	357 (15.4%)	282 (45.9%)	1,554 (16.6%)
Kalimantan	53,946 (28.1%)	593 (8.8%)	274 (9.8%)	6,204 (4.5%)	89 (1.4%)	9 (0.4%)	1 (0.2%)	99 (1.1%)
Sulawesi	18,922 (9.9%)	638 (9.5%)	830 (29.5%)	9,817 (7.2%)	848 (13.2%)	376 (16.3%)	183 (29.8%)	1,407 (15.1%)
Maluku & Irian Jaya	49,649 (25.9%)	-*) -	- -	2,358 (1.7%)	18 (0.3%)	- -	- -	18 (0.2%)
T o t a l	191,946 (100.1%)	6,718 (100.0%)	2,810 (100%)	136,417 (99.9%)	6,423 (100%)	2,311 (100%)	614 (100%)	9,348 (100%)

Source : Statistical Pocketbook of Indonesia, 1979/ 1980.

*) : Some data for Maluku and Irian Jaya are unavailable.

IV-1-3. Animal Husbandry in South Sulawesi :

In recent years South Sulawesi emerged as a cattle producing center in Indonesia. According to the Statistical Pocketbook of Indonesia, the number of cattle in South Sulawesi has increased rapidly from 312,000 heads in 1972 to 567,000 in 1978, despite the gradual decrease suffered by most of the other regions. A more optimistic information from the Annual Report issued by the Provincial Animal Husbandry Service shows that 230,000 heads of cattle in 1969/ 1970 have raised to 817,000 heads in 1980/1981, being multiplied 3.5 times as much during nearly one decade. In 1978 South Sulawesi exported 2,348 breeding cattle and 10,431 slaughter cattle to other regions of Indonesia.

The cattle breed dominant in South Sulawesi is Bali cattle (Bos sondaicus) which is originally wild cattle indigenous to Java and Sumatra and has been domesticated in Bali island for over 900 years. It was not until the early stage of the 20th century that Bali cattle were introduced for the first time to South Sulawesi by Dutchmen. However, this deer-like, alert and hardy animal has propagated itself very rapidly all over South Sulawesi with its inherent high fertility. Although well adapted to the environment, Bali cattle is still poor in growth rate, final weight, milk production, etc.

Bali cattle is raised mainly for the purpose of draft, or as a means of saving and propagating farmers' properties. Bali cattle as well as water buffaloes are often seen plowing the paddy field, but seldom used to draw a cart. Livestock is generally an important source of income, especially for the farmers in the mountain districts where other kinds of cash crops are scarce. They may dispose of their livestock in case of bad harvest, festivity, or other necessities, i.e. for house repair, furniture procurement, school fee, etc.

Cattle is allowed to graze round freely anywhere as far as it causes no damage to the cultivated crops. During the dry season, non-irrigated paddy fields turn out to be a vast open grassland in which herds of livestock graze rice straws remaining after harvest and other natural grasses. When paddy fields are under cultivation, cattle is kept in the homeyard or other vacant spots; otherwise it will be kept in the hilly districts nearby and managed with periodic supply of salt. In the mountains, farmers usually bring and tether their cattle in search of abundant forages, the sites often competitive with the afforestation project. Where the dry season is distinct, there is sometimes a lack of forages, so the livestock farmers are obliged to supply aditional feed like banana or papaya stalks, and every other agricultural by-products.

As a characteristic of South Sulawesi, there are some large animal husbandry undertakings such as P.T United Livestock or P.T Bina Mulya Ternak which cover some thousands hectares of grasslands. The large scale ranch construction was enabled after the gang soldiers opposing the central government were wiped out in 1965. Blessed with favorable natural conditions both in climate and topography, these government sponsored enterprises are taking progressive measures in order to promote animal husbandry technology in this region.

Contribution made by South Sulawesi Province Animal Husbandry Service cannot be neglected for the successful achievements in this sphere. For the prevention of animal epidemic diseases, livestock are put into quarantine at Parepare before transferred to other islands. At abattoirs animals are to be checked before slaughter, from the viewpoint of meat hygiene. Disease Investigation

Table 2. Present Condition of Land-use by Kabupaten & Block in South Sulawesi Province (1976).

Unit : 1,000 ha.

Kabupaten	Forest area	Grass-land area	Shifting cultivation area	Upland area	Paddy field area	Swamp forest area	Fish pond area	Salt farm area	Others	Total
1. U. Pandang	-	-	-	1.3	4.0	0.1	1.5	-	4.7	11.6
2. M a r o s	59.5	9.6	8.5	24.1	21.7	0.1	4.4	-	10.2	138.1
3. Pangkep	17.5	1.8	3.7	19.8	20.9	0.2	5.2	0.6	15.1	48.8
4. G o w a	70.3	12.8	14.1	39.6	30.2	0.2	0.2	-	7.3	175.0
5. Takalar	19.5	2.1	1.8	12.3	16.1	0.4	2.0	0.4	0.4	55.0
6. Jeneponto	25.9	15.1	0.4	30.9	13.7	0.2	1.9	1.0	0.2	79.3
7. Bantaeng	8.5	1.6	-	25.6	5.0	-	0.1	-	0.9	41.5
8. Bulukumba	17.3	1.4	7.4	57.3	22.4	0.3	3.8	-	3.3	113.2
9. Selayar	18.0	3.4	19.1	14.7	0.8	0.9	0.1	-	6.3	63.3
10. Sinjai	22.9	12.9	20.9	20.3	10.5	0.1	0.5	-	4.1	92.0
T o t a l	249.4	60.5	76.2	245.9	145.3	2.5	19.7	2.0	52.3	853.8
11. B o n e	163.0	80.5	28.3	68.5	74.2	7.9	4.9	-	12.4	439.7
12. W a j o	37.2	32.5	3.7	64.8	68.3	21.1	6.6	-	8.5	242.7
13. Soppeng	49.0	6.2	-	49.7	21.7	-	-	-	7.7	134.3
T o t a l	249.2	119.2	32.0	138.0	164.2	29.0	11.5	-	28.6	816.7
14. B a r r u	79.6	-	6.6	11.5	11.5	1.4	2.0	-	7.8	119.4
15. Pare-pare	4.3	-	-	2.5	0.9	0.1	-	-	3.3	11.1
16. Pinrang	63.6	20.0	5.7	34.8	46.9	1.6	6.5	-	7.3	186.4
17. Sidrap	71.2	35.6	3.5	26.4	45.1	0.2	-	-	8.0	190.0
18. Enrekang	95.1	34.3	14.0	17.3	9.0	-	0.1	-	14.3	184.1
T o t a l	313.8	89.9	29.8	92.5	113.4	2.3	8.6	-	40.7	691.0
19. Polmas	248.0	48.1	29.6	76.7	20.2	1.2	2.8	-	48.4	475.0
20. Majene	50.0	23.9	2.6	9.9	1.1	0.2	0.6	-	5.7	94.0
21. Mamuju	620.0	149.4	27.6	145.0	1.5	4.0	0.1	-	79.9	94.0
T o t a l	918.0	221.4	59.8	231.6	22.8	5.4	3.5	-	134.0	1.596.5
22. Tator	184.6	48.5	9.9	37.2	17.8	-	-	-	23.6	321.6
23. Luwu	1,307.1	50.5	50.1	118.9	45.3	10.8	3.1	-	427.4	2,013.2
Total	1,491.7	99.0	60.0	156.1	63.1	10.8	3.1	-	451.0	2,334.8
G.Total	3,222.1	590.0	257.8	909.1	508.8	50.0	48.4	2.0	708.0	6,292.8

Source : South Sulawesi Regional Agricultural Development Planning/ATA-140 Project Final Report on Phase I, Volume III.

Center in Maros also contributes much to the identification of prevalent disease and vaccination against Anthrax, foot-and-mouth disease, Septicemia Epizootica, etc. in each kabupaten. Foot-and-mouth disease is said to have been eradicated out of South Sulawesi. For the purpose of cattle upbreeding, some schemes are conducted, i.e. introduction of Brahman cross breed from Australia, implementation of artificial insemination to produce cross breeds between native Bali cattle and European breeds, etc. Credit system through the Bank Rakyat Indonesia, supplying cattle together with some other necessities helps farmers who are eager to engage themselves in livestock production. Besides large animal husbandry undertakings, small-scale ranches, the so-called " mini ranch ", are also managed in various ways.

The increasing livestock population inevitably brings about new problems, i.e. forage deficiency and land devastation. Grasslands as well as roadside grasses are generally found to be grazed very short, and in mountain areas, regreening programs are often hampered by cattle repeatedly intruding into the afforestation site. In order to cope with these problems as well as to improve the nutritive value of the feed, forage crop gardens are demonstrated in each kabupaten. Some other grassland improvement trials have been made by the government-sponsored ranches, too. Nevertheless, farmers in general, instead of showing enthusiasm in forage cultivation, still keep managing to find native grasses and other agricultural by-products that can be obtained free of charge. With the background mentioned above, the Grassland Improvement Project was proposed as one of the sectors of the ATA-140 Project entitled the South Sulawesi Regional Agricultural Development Planning. It might offer a new challenge to the development and conservation of the critical mountain districts by way of livestock production which is one of the biggest problems to be solved for the future development and food supply in Indonesia.

IV-2. Outline of the Pilot Test Site

IV-2-1. Animal Husbandry in Kabupaten Enrekang :

Enrekang, one of the 23 kabupaten-s in South Sulawesi, is located in the central part of the mountain district of the Province. Kabupaten Enrekang has an area extending 1,841 km2, covering five Kecamatan-s and 28 Desa-s, with a population of 130,361 for 1979/1980. In topography, southernmost kecamatan of Maiwa shows a conspicuous contrast to the other 4 kecamatan-s. Kecamatan Maiwa is the most favored area for ranch construction with abundant gentle sloping grasslands. P.T Bina Mulya Ternak has its Maiwa ranch which covers 5,000 ha., while some other medium-sized ranches can also be found in this area. The four other kecamatan-s : Alla, Anggeraja, Baraka and Enrekang, are characterized by their steep and complicated topography. Because of such a land condition, paddy field is scarce, while forest, grassland, shifting cultivation and upland areas are widespread (Refer to Table 2). The amount of annual rainfall varies from place to place, possibly influenced by topography, but generally not so abundant compared with the other regions of Indonesia. In the mountain districts, being influenced by both the northwest and southeast monsoons, the dry season is not so distinct (See Table 3).

Table 3. Amount of Rainfall in Kabupaten Enrekang in 1979

Month	Enrekang St. (mm)	Rainy days	Baraka St. (mm)	Rainy days	Alla St. (mm)	Rainy days
January	310	11	46	7	66	11
February	159	10	135	16	260	19
March	261	7	147	13	280	12
April	216	8	138	13	31	11
May	23	4	96	14	41	9
June	331	9	116	15	49	4
July	79	4	46	7	65	6
August	9	2	3	2	19	2
September	63	7	48	6	26	7
October	3	1	11	1	3	2
November	99	11	96	11	13	7
December	197	9	166	15	X	X
Total	1,750	83	1,044	120	611	90
Average	146	7	87	10	51	8

Source : Kabupaten Enrekang Animal Husbandry Service 1979/1980.

Livestock population of Kabupaten Enrekang in 1979/1980 is shown on Table 4.

Table 4. Livestock population of kabupaten Enrekang in 1979/1980

	Head
1. Horses	7,387
2. Cattle	22,581
3. Water buffaloes	11,017
4. Goats	22,783
5. Sheep	56
6. Pigs	234
7. Chicken	843,522

8. D u c k s	18,971
9. Manila ducks	70,034
10. G e e s e	2,233

Source : Kabupaten Enrekang Animal Husbandry Service.

Population of large livestock (cattle, water buffaloes and horses) per 1,000 human population is extremely high in kabupaten Enrekang (Table 5), which indicates the farmers' attachment to livestock as an important source of income. Distribution of water buffaloes is strongly overlapped by that of the paddy field for its physiological affinity to water. In the northern kecamatan-s, female buffaloes are milked, and the milk is then processed traditionally, applying papaya sap, to produce a kind of cheese called " dangke ". Buffaloes are mainly traded to Kabupaten Tana Toraja where the native people usually slaughter a lot of buffaloes in the course of their interesting traditional funeral ceremonies. Horses are employed to carry loads on their backs, especially in the mountain districts, for the convenience to toil up and down steep slopes and unpaved lanes.

Farmers prefer to raise cattle chiefly for the purpose of saving and propagating their properties. The habit of turning cattle loose on slopes or forests is still prevailing, and sometimes cattle are kept half wild, hovering round in search of forages in the mountains. Cattle are sometimes raised by unwritten contract between the owner and the herdsmen. When cattle are turned loose, the youngs are divided in three, one-third for the herdsmen and two-thirds plus the original mother cattle for the owner. When turned into stables at night, the youngs are divided in two, half for the herdsmen and the other half plùs the original mother cattle for the owner. Much of the cattle in this region is marketed to Kalimantan through the port of Pare-pare, and the transfer of the cattle is conducted by both interregional and interinsular middlemen, which make the trading system inefficient.

The kabupaten Enrekang Animal Husbandry Service performs activities of the development project as follows :

i). Castration/selection of male livestock unqualified to be a good breed;

ii). Prohibition of the shipment of breeding bulls from the kabupaten without consent of the Regional Administration;

iii). Restriction of livestock shipment to 10% of the population of the year concerned;

iv). Strict control on the slaughtering of young cows;

v). Eradication of contagious animal diseases by continuous mass vaccination and inspection of livestock delivered out of the region;

vi). Extension of credit cattle offered by the Rural Credit Project of Bank Rakyat Indonesia;

vii). Extension of technical guidance for intensive livestock management;

viii). Establishment of a Forage Crop Center for forage production and quality improvement.

Table 5. Livestock Population per 1,000 Human Population (1979/1980)

	(1) Human Population x 1,000	Livestock population x 1,000				(2)/(1) x 1,000 Livestock per 1,000 human population.
		Cattle	Buffalo	Horse	(2) Total	
Kab. Enrekang	130	23	11	7	41	315
South Sulawesi	5,838	567	357	163	1,087	186
Sulawesi	9,817	848	378	183	1,409	144
Indonesia	136,416	6,423	2,312	615	9,350	69

Source : Statistical Pocketbook of Indonesia 1979/1980
Kabupaten Enrekang Animal Husbandry Service 1979/1980.

Together with the kabupaten-s of Bone and Barru, the northern part of kabupaten Enrekang was appointed to be the region for development and conservation of " pure Bali cattle " based on the policy of the provincial administration. In recent years artificial insemination was introduced to make crossbreeds between Bali cattle and European breeds, aiming at the upgrading of the body size. In the fields, crossing with Ongole cattle is also being conducted by natural mating. Brahman cross breed imported from Australia might play some role for the improvement of the native cattle. But, as a matter of fact, it is very difficult to evaluate the multilateral quality of livestock; and there is no assurance that crossbreeding can lead to any desirable results as well. In such a situation, a good quality of pure Bali cattle should also be preserved for the future prospect of Indonesian animal industry. Considering that Bali island is still afflicted with Jembrana disease peculiar to Bali cattle, South Sulawesi will have to take a more important role to supply excellent quality Bali cattle for the promotion of animal husbandry in the developing regions of outer islands.

The northern part of kabupaten Enrekang has another aspect as a water conservation area to support irrigation for the neighboring rice producing districts. The afforestation/reforestation project is under way for the afforestation of these denuded critical areas; however, this nation-wide governmental scheme is reported to have been hampered by several reasons. According to the members concerned, livestock intrusion into the *regreening site* is also one of the afflicting problems, so that the practice of grassland improvement is urgently needed from the viewpoint of land conservation as well.

IV-2-2. Situation of the Grassland Improvement Project Site :

The Grassland Improvement Project site is located in the mountain areas of South Sulawesi (latitude 3°S, longitude 121°E) which belongs to Desa Buntu Barana, Kecamatan Alla, Kabupaten Enrekang. This grassland extends about 500 ha., at an altitude of 900 to 1,000 m. above sea level. The project site occupies the north-western flank of Mt. Maliba (1,118m. above sea level), bordered along the northern edge by the Mata Allo River which flows between Kabupaten Enrekang and Kabupaten *Tana Toraja*.

It is supposed that the natural grassland is generated as result of *shifting* cultivation and maintained by repeated grazing of livestock for centuries. In 1975 the South Sulawesi Animal Husbandry Service introduced 50 heads of 1½ year old Bali cattle (5 male and 45 female) for the first time into the project site. The number of cattle reached 135 as of November 1981. For a long time the neighboring farmers have been making use of the project site as a pasture for their buffaloes. Since the start of the project activity, the buffaloes have been prohibited to graze at the project site; however, they constantly intrude into the site, grazing together with Bali cattle. Cattle here are still kept in half-wild condition without any care except for occasional supply of salt.

Climate and land condition are the two big factors determining agricultural production in each region. Briefly speaking, the project site is characterized by its favorable climate and poor land condition both in soil fertility and in topography. Being situated in a highland near the equator, the temperature ranges between 17 and 30°C throughout the year. For the measurement of rainfall, a simple pluviometer has been installed adjacent to the residence of the former village chief since medio February 1980. According to data observed, rainfall for the first one year (March 1,1980 through February 28,1981) amounted to 1374.5 mm. with 109 rainy days. Annual rainfall in 1981 amounted 1958.6 mm. with 148 rainy days (Table 6). Neither *a distinct dry season* nor excessive rainfall could be observed during the period, and natural grasses are kept almost evergreen, *suitable for grazing*. During the dry season, some plots of the grassland are accidentally burnt, claiming no significant damage.

Soil analysis is conducted with the cooperation of the Hasanuddin University staff. Soil samples are collected from different parts of the project site according to topographic and vegetational conditions, and then divided into two layers, i.e. 0 - 15 cm. and 15 - 30 cm. in depth. The soil type is classified as Podsolic which covers 77% of the Kabupaten. The abstract of the soil analysis is shown on Table 7. The silty clay soil is mostly in poor quality characterized by its low pH and mineral deficiency. Except on the forage nursery bed (Code F) where much dung is accumulated, the soil pH ranges from 3.4 to 4.6 by analysis with water, and from 3.1 to 4.2 by KCI analysis, which indicates excessive soil acidity. As for the three major elements, P and N are seriously deficient, while K which can be easily restored by livestock urine is sufficient in quantity.

Table 6. Amount of Rainfall at Rante Limbong, Desa Buntu Barana

Month	1980		1981	
	Rainfall mm.	Rainy days	Rainfall mm.	Rainy days
January	-	-	8.6	1
February	-	-	120.1	12
March	94.5	11	304.3	18
April	268.7	20	233.8	16
May	50.5	9	162.6	13
June	357.1	14	147.2	15
July	36.8	6	189.5	14
August	78.5	5	89.9	4
September	5.0	1	146.3	12
October	143.3	6	228.5	15
November	96.9	13	265.1	19
December	114.5	11	62.7	9
			1958.6	148

Source : Observation by the Ex-Village Chief Mr. Thahir at his residence.

Reflecting a low pH, Calcium and Magnesium are also deficient. Soil quality seems to be much improved with the accumulation of dung on the surface.

Grassland vegetation is kept very steady owing to constant climate and repeated grazing by livestock. Native grasses are dominant all over the area which can be divided into palatable and less palatable ones, based on the

Table 7. Soil Analysis at the Project Site

No.	Code No.	Soil Layer (cm.)	pH (1:1)		m, equivalent /100 gr. soil				
			H20	KCl	NTK	Ca^{++}	Mg^{++}	K^{+}	Na^{+}
1	2	3	4	5	6	7	8	9	10
1.	A_1	0 - 15	4,5	4,1	19,55 (m)	10,056 (m)	1,944 (m)	8,83 (m)	-
2.	A_2	15 - 30	4,2	4,0	15,20 (m)	0 (el)	0,254 (el)	5,67 (l)	-
3.	B_1	0 - 15	4,3	4,0	18,55 (m)	10,056 (m)	1,94 (m)	8,81 (m)	-
4.	B_2	15 - 30	4,0	3,9	19,20 (m)	0 (el)	0,254 (el)	5,67 (l)	-
5.	C_1	0 - 15	4,7	4,1	19,5 (m)	0,592 (el)	0,592 (l)	9,23 (h)	-
6.	C_2	15 - 30	4,4	3,1	21,9 (m)	0,507 (el)	1,014 (m)	7,69 (l)	-
7.	D_1	0 - 15	4,6	4,1	20,9 (m)	1,352 (el)	0 (el)	9,48 (h)	-
8.	D_2	15 - 30	4,6	4,2	20,9 (m)	1,352 (el)	0 (el)	9,48 (h)	-
9.	E_1	0 - 15	3,4	3,1	11,6 (l)	0,930 (el)	1,352 (m)	27,62 (h)	-
10.	E_2	15 - 30	3,4	3,1	11,6 (l)	0,930 (el)	1,352 (m)	27,62 (h)	-
11.	F_1	0 - 15	5,4	4,2	19,0 (m)	8,366 (m)	1,352 (m)	30,85 (h)	-
12.	F_2	15 - 30	4,4	3,2	18,7 (m)	9,971 (m)	0,169 (el)	31,02 (h)	-
13.	G_1	0 - 15	4,5	3,2	12,15 (m)	0 (el)	0 (el)	10,57 (h)	-
14.	G_2	15 - 30	4,5	3,2	12,15 (m)	0 (el)	0 (el)	10,57 (h)	-

Code Number :

A = Inside the tall-type grassland experimental site
B = Beside the tall-type grassland experimental site
C = Inside the short-type grassland experimental site
D = Beside the short-type grassland experimental site
E = Typical grassland vegetation at the project site
F = Fertile Brachiaria decumbens nursery bed with dung
G = Sterile grassland with poor soil.

Table 7. Soil Analysis at the Project Site

No.	Code No.	Organic	Total	Effective P (ppm) +	Effective P (ppm) ++	Texture Clay	Texture Silt	Texture Sand	Classification
		11	12	13	14	15	16	17	18
1.	A_1	2,527	0,06 (el)	3,2 (l)	-	39,14	47,88	12,98	Silty clay loam
2.	A_2	1,825.	0,24 (h)	4,0 (h)	-	48,83	46,70	4,47	Sandy clay loam
3.	B_1	2,520	0,16 (l)	3,1 (l)	-	38,14	47,80	12,96	Silty clay loam
4.	B_2	1,820	0,20 (m)	4,0 (l)	-	48,80	45,80	4,47	Sandy clay loam
5.	C_1	2,410	1,00 (h)	5,2 (l)	-	32,28	64,63	3,09	Silty clay loam
6.	C_2	0,928	0,10 (l)	2,0 (el)	-	62,81	23,94	13,25	Clay
7.	D_1	1,053	0,13 (l)	3,2 (l)	-	39,08	52,33	8,59	Silty clay loam
8.	D_2	1,053	0,13 (l)	3,2 (l)	-	39,08	52,33	8,59	Silty clay loam
9.	E_1	1,131	0,08 (el)	1,2 (el)	-	41,60	48,04	10,36	Silty clay
10.	E_2	1,131	0,08 (el)	1,2 (el)	-	41,6	47,04	10,30	Silty clay
11.	F_1	3,214	0,64 (h)	6,4 (l)	-	38,74	42,6	18,66	Silty clay loam
12.	F_2	2,349	0,38 (m)	2,4 (l)	-	43,48	51,54	4,98	Sandy clay
13.	G_1	2,215	0,05 (el)	2,4 (el)	-	17,45	15,42	27,13	Silty loam
14.	G_2	2,215	0,05 (el)	2,4 (el)	-	17,45	15,42	27,13	Silty loam

(h) = h i g h

(m) = medium

(l) = l o w

(el) = extremely low

different degrees of palatability. Palatable grass species are generally grazed very frequently and kept in good quality, while less palatable ones are scarcely grazed and remain tall in height. Although popular in tropical grasslands, alang-alang (Imperata cylindrica) is scarcely found at the project site. Bracken ferns are found in some remote sloping areas where cattle are reluctant to graze. Shrubs are limited to the side of streams. Pinus merkusii which were afforested are seen on the grassland and its vicinity. There are some critical areas where land erosion is feared to occur because of the complicated topography and cattle intrusion.

The project site had been isolated from the other regions for a long time before cattle were introduced for the first time in 1975; this fact is what makes the site free from epidemic diseases inherent in cattle. Wild hogs, in an unknown number, are actively causing damage to the cultivated crops. Stableflies swarm around the cattle, while ticks and horseflies have never been observed. Grass hoppers and other ordinary insects except for ants are scarce.

Table 8. Classification of the Grassland Condition

- Vegetation
  - Grasses
    - Palatable (short-type)
    - Less palatable (tall-type)
  - Ferns and other weeds
  - Shrubs
- Bare lands
  - Eroded areas
  - Cattle tracks (cattle trails)

IV-3. Pilot Tests and Ranch Construction

IV-3-1. Evaluation of the Native Grassland :

(1). Introduction :

The majority of livestock in Indonesia still depends on native grasses that can be obtained throughout the year. According to the theory of evolution, those species dominant in each region are regarded as the ones which have survived through natural selection in the long history of evolution, and it is considered that the fittest species organize the dominant vegetation. The native grassland at the project site is steady, and resistant to the impact of grazing and trampling by livestock.

Since the effective use of native grasslands is among the important development schemes, the potential productivity of native grasses should be clarified at first to evaluate the carrying capacity. Response of native grasses to fertilizer application is also examined from the viewpoint of economic feasibility study.

(2). M e t h o d s :

<u>Location</u> : The project site of the RADP/ATA-140 lies about 900 m. above the sea level, in latitude 3°S. Native grasslands have been used for grazing for a long time. Soil qualities are shown on Table 7. Short-type grassland : Gentle slope that faces north. Consists of palatable native grasses, extending 20 x 20 m. Tall-type grassland : Flat land for the most parts. Consists of less palatable native grasses; extending 20 x 30 m.

<u>Preparation</u> : A fence was constructed at the end of February 1980 to protect the experimental site from livestock intrusion.

<u>Treatments</u> : The short-type and tall-type grasslands are divided into the Non-fertilizer (N), Standard fertilizer (S) and Double fertilizer (D) plots respectively. Five pieces of fixed quadrats are set in each plot. Fertilizer is applied 4 times a year, at the amount of N:P:K = 130:130:130 kg. per hectare per year (S), and twice as much (D). For the purpose of excluding the outside influences, the same treatment is given with 50 m's width around the quadrats.

<u>Survey</u> : Fresh grass weight, maximum leaf height, vegetational cover and bare land percentage are measured when the vegetation is observed to be suitable for grazing. Stolons are difficult to be measured properly and the height of occasional tall stalks are neglected.

(3). Results and Discussion :

The potential productivity of the native grassland can be observed in the Non-fertilizer plots. In the short-type grassland, the fresh weight of native grasses amounted to 13,250 kg. per ha. for the first year and 17,800 kg. for the second year. In the tall-type grassland, the figure is 15,940 kg. per ha. for the first year and 18,260 kg. for the second year (Table 9). Lignification inherent in tropical grasses is marked in stalks and stolons, so that dry matter ranges from 30 - 35%. Supposing a Bali cattle with a body weight of 250 kg. takes as much fresh grass as 15% of its body weight per day, the feed intake per year amounts to 13,688 kg. (250 kg. x 0.15 x365 days = 13,688 kg./year), which shows that one ha. of native grassland is necessary at least to provide forage for each head. But considering that the general condition of the grassland is worse than that of the experimental site both in topography and in vegetation, and that grasses are repeatedly damaged by untimely grazing, treading and other factors, the size of the grassland required per head is estimated to be two hectares or more.

Native grass production is enhanced by fertilizer application. In the short-type grassland, the production is multiplied 2.6 times as much for the first year and 2.3 times for the second year in case of the standard fertilizer (1,000 kg./ha./year of compound fertilizer N:P:K = 13:13:13), and 4.7 times, 4.1 times as much respectively in the Double fertilizer plots (2,000 kg./ha./year of the same fertilizer composition). Fertilizer response is rather dull in the tall-type grassland experimental site. The production is 1.8 times as much for the first year and 2.0 times for the second (standard fertilizer), and 2.7 times, 3.1 times as much respectively (double fertilizer application). No significant difference being noticed in soil quality (Table 7), the different fertilizer response between the short-type and tall-type grasslands seems to be caused by the different vegetational composition, i.e. Cenchrus spp. which shows a sharp response to fertilizer application is more abundant in the short-type grassland. Although fertilizer response during the second year declined, the amount of grass production of each testing plot was enhanced due to abundant rainfall.

The vegetational condition in each test plot is kept almost constant throughout the experimental period (Refer to Table 10). The leaf height and vegetational cover are improved, while bare lands are remarkably reduced by the application of fertilizer. Different fertilizer response is observed among each grass species, especially the growth of Cenchrus spp. stolons is conspicuously accelerated by fertilizer application. The quality of native grasses is remarkably improved by periodic cutting and fertilizer application. On August 31, 1980 two water buffaloes intruded into the short-type grassland testing site and grazed all the grasses under investigation. Grasses outside the testing plots being untouched, the native grassland with periodic cutting and occasional fertilizer application has proved to be improved in palatability, too.

Prohibiting grazing, the native grassland vegetational succession is studied. At the short type grassland experimental site, the standing crop shows a linear increase in proportion to the ungrazed period for the duration of almost two years. While at the tall-type grassland site, attaining linear increase of standing crop for the first 13.5 months, it declines in the succeeding period. In the short-type grassland the standing crops at the non-grazing area are lower than the periodically harvested accumulative sum at each equivalent period, while in the tall-type grassland experimental site both of the figures are kept almost constant only for the first year. As the vegetational succession proceeds, grass height and vegetational cover are improved, but on the other hand, bare land% spread seriously.

Table 9. Productivity and Fertilizer Response of Native Grasses

(Fresh weight kg./ha.)

Date \ Treatment	Short-type Grassland			Tall-type Grassland		
	N	S	D	N	S	D
1980						
△ April 9	(1,360)	(1,360)	(1,100)	(1,300)	(1,550)	(1,680)
1) △ May 28	3,040	7,600	14,420	2,840	5,200	8,700
2) June 30	-	4,880	7,860	-	4,140	7,300
3) △ Sep. 2	2,050*	5,350*	9,580*	4,980	3,760	4,880
4) Nov. 19	2,060	3,360	6,500	2,000	3,980	6,120
5) △ Dec. 18	1,740	4,580	8,700	1,940	3,840	5,120
1981						
6) Jan. 15	-	2,760	5,840	-	2,180	3,820
7) Mar. 18	2,860	3,080	4,900	1,560	2,240	2,840
8) △ Apr. 15	1,500	2,880	4,000	2,620	4,120	3,560
Sub-total	13,250	34,490	61,300	15,940	29,460	42,340
(Ratio)	(1.0)	(2.6)	(4.7)	(1.0)	(1.8)	(2.7)
1981						
9) May 13	-	3,920	13,700	-	7,780	11,200
10) △ June 9	3,320	3,620	6,860	3,600	3,700	3,740
11) July 20	2,800	8,740	13,800	2,400	4,860	7,200
12) △ Sep. 16	-	3,080	4,460	-	4,240	4,360
13) Nov. 9	4,320	5,940	10,520	5,640	6,920	9,980
1982						
14) △ Jan. 13	3,940	6,840	7,380	3,340	3,860	5,540
15) Mar. 16	3,420	9,000	16,100	3,280	5,680	13,780
Sub-total	17,800	41,140	72,820	18,260	37,040	55,800
(Ratio)	(1.0)	(2.3)	(4.1)	(1.0)	(2.0)	(3.1)
T o t a l	31,050	75,630	134,620	34,200	66,500	98,140
(Ratio)	(1.0)	(2.4)	(4.3)	(1.0)	(1.9)	(2.9)

Remarks : △ - Fertilizer application
( ) - Initial standing crop weight
* - Estimated weight

Table 10. Vegetational Change
(Maximum leaf height, Vegetational Cover, Bare land)

Treatment / Date	Short-type Grassland			Tall-type Grassland		
	(N)	(S)	(D)	(N)	(S)	(D)
Maximum leaf height (cm)						
1980 April 9	(28)	(29)	(24)	(47)	(46)	(42)
May 28	30	32	42	43	36	35
Nov. 19	26	29	36	31	40	31
1981 May 13	28	25	29	35	34	29
Nov. 9	37	38	46	41	38	46
1982 Mar. 16	30	36	44	32	36	47
Vegetational Cover (%)						
1980 April 9	(78)	(76)	(75)	(74)	(72)	(75)
May 28	70	91	99	61	84	86
Nov. 19	73	84	94	66	82	87
1981 May 13	61	84	95	69	94	95
Nov. 9	80	91	92	61	89	92
1982 Mar. 16	70	87	96	63	79	95
Bare land (%)						
1980 April 9	(41)	(41)	(46)	(51)	(46)	(46)
May 28	44	35	25	51	40	46
Nov. 19	42	24	16	53	33	24
1981 May 13	68	41	25	55	26	23
Nov. 9	43	34	28	49	35	27
1982 Mar. 16	48	38	27	58	42	27

( ) - Initial standing crop vegetation.

The aged grasses become coarse, less palatable, and its leaves and stalks are liable of being withered. Lodging is not so widely observed, but the aged grasses may be subject to damage by grazing activities of the cattle herd. Further observation and trials are required in the formation of deferred rotational grazing scheme.

Suppose 1,000 kg. of fresh grass contains 4 kg. N, 1 kg. P_2O_5, 6 kg. K_2O, the balance between deprivation and supply of the three major elements is as shown in Table 12. As plant growth is regulated by complex interaction of many factors, it is difficult to judge the effect of each different factor, and the limiting factor on the plant growth still remains uncertain. But on the assumption that mineral deprivation as a consequence of grass production in the non-fertilizer plots is equivalent to the natural supply from the soil and the same amount of those elements can be naturally supplied as well in the case of the fertilized plots, mineral elements supplied by means of chemical fertilizer, except P_2O_5, seems to be efficiently absorbed in this limited range of application, especially in the short type grassland. In the tall type grassland it is considered that other unidentified minor factors are concerned with grass production.

Table 11. Vegetational Succession in the Non-grazing Areas

a). Short-type Grassland

Date (months) \ Measurement	Standing crop (kg/ha)	Maximum leaf ht. cm.	Veget. cover (%)	Bare land (%)
1980 April 9 (1.5)	1,270	27	76	45
Sept. 3 (7.0)	4,860	52	61	58
1981 Jan. 16 (10.5)	10,130	61	92	40
April 17 (13.5)	10,470	71	87	70
Nov. 25 (21.0)	17,080	87	89	77
1982 Feb. 18 (23.5)	18,000	103	92	80

b). Tall-type Grassland

Date (months) \ Measurement	Standing crop (kg/ha)	Maximum leaf ht. (cm)	Veget. cover (%)	Bare land (%)
1980 April 9 (1.5)	1,510	45	74	48
Sept. 2 (7.0)	8,960	74	85	39
1981 Jan. 16 (10.5)	12,270	79	97	57
April 17 (13.5)	16,330	86	97	70
Nov. 25 (21.0)	13,080	86	87	74
1982 Feb. 18 (23.5)	14,500	92	90	80

( ) = non-grazing period since the end of February 1980.

Table 12. Deprivation and Supply of N, P_2O_5, and K_2O on Native Grasslands

Treat-ment.	Fresh grass annual production kg/ha. (A)	N,P,K content /1000kg fresh grass (B)	Deprivation (kg) (A)x(B) / 1000 = (C)	Supply (kg) Natural (D)	Fertilizer (E)	Total (D)+(E) = (F)	Deprivation Rate (C)/(F)
Short-type (N)	13,250	N = 4	53	53	-	53	1.00
		P = 1	13	13	-	13	1.00
		K = 6	80	80	-	80	1.00
Short-type (S)	34,490	N = 4	138	53	130	183	0.75
		P = 1	34	13	130	143	0.24
		K = 6	207	80	130	210	0.99
Short-type (D)	61,800	N = 4	247	53	260	313	0.79
		P = 1	62	13	260	273	0.23
		K = 6	371	80	260	340	1.09
Tall-type (N)	15,940	N = 4	64	64	-	64	1.00
		P = 1	16	16	-	16	1.00
		K = 6	96	96	-	96	1.00
Tall-type (S)	29,460	N = 4	118	64	130	194	0.61
		P = 1	29	16	130	146	0.20
		K = 6	177	96	130	226	0.78
Tall type (D)	42,340	N = 4	169	64	260	324	0.52
		P = 1	42	16	260	276	0.15
		K = 6	254	96	260	356	0.71

(N) : Non-fertilizer   N = Nitrogen

(S) : Standard fertilizer   P = P_2O_5

(D) : Double fertilizer   K = K_2O

Grass production increase by means of fertilizer application to the native grassland is quicker and easier than that by forage crop introduction, which requires soil cultivation, or grass transplatation. Moreover, it may avoid risks inevitable in any exploitation activities. But remarkable improvement would hardly be expected with native grasses, and great expense on fertilizer which is a great burden for grassland management cannot be negleted. Consequently, one should always try to collect the precise data on the effect of fertilizer application in oder to make efficient use of it, avoiding every possible loss to occur. Economically, the application of Urea and TSP (Tri-Super Phosphate) can be recommended because prices of these are kept comparatively low by the governmental aid.

IV-3-2. Rotational Grazing Intervals on the Native Grassland.

(1). Introduction :

The practice of free grazing system without any facility and planning is, to be sure, advantageous from the viewpoint of saving both capital and labor. On the contrary, however, it causes certain inefficiency in forage and cattle productivity, bringing about some damages to the grassland. If the cattle herd is set free in the midst of spacious open grassland of different conditions, the herd inclines to go grazing around within the limited range of the grassland. As a consequence, some favorably located areas suffer overgrazing, while in the other remote areas grasses are left ungrazed, getting coarse, underfed as well as unpalatable. Critical areas with steep slopes will suffer serious devastation by the intrusion of cattle herd and their repeated treading. Cattle trails are also liable to be formed, especially in the sloping areas. The traditional way of cattle management also causes a certain energy loss to the cattle when they go round a long way in search of forages. The energy loss of calves is among other things of vital importance as they are obliged to walk a long distance following their dams as soon as they are born in the field. In order to cope with the problems, the implementation of rotational grazing in terms of more intensive cattle management is required. In this connection, a simple experiment is designed to determine suitable rotational grazing intervals on the native grassland.

(2). Methods :

Location : The project site of the RADP/ATA-140 lies adjacent to the tall-type grassland experimental site. An almost flat native grassland with uniform vegetation. Soil qualities are shown on Table 7.

Preparation : Before the start of the experiment, the site is kept ungrazed for about ten months, from the end of February until October 15, 1980. The standing crop fresh weight at the site is 6,550 kg/ha. as of October 15, 1980.

Design : The productivity of native grasses is compared among the three levels of different cutting intervals, i.e. monthly, bimonthly and trimonthly. Each testing plot is 2 x 2 = 4 m2 large, and three repetition plots for each level are arranged according to the Latin squares design. 50 cm. wide buffer belts are set between the testing plots to eliminate the interactions. Fertilizer application is not conducted.

Survey : Fresh grass weight, maximum grass height, vegetational cover and bare land percentage are measured in the middle third of a month. Stolons are difficult to be measured and the height of occasional tall stalks in ears are neglected.

(3). Results and Discussion :

According to the data obtained during the first one year, the annual average of maximum leaf height at the time of harvest increase with the length of each growing period, i.e. 24 cm. for monthly cutting, 37 cm. for bimonthly and 40 cm. for trimonthly. Consequently the grasses are observed to attain steady growth within the given survey period. Occasionally, some of the stalks show a rapid growth with their spikes on the top, reaching over 100 cm. in height within two or three months' growth period. As fertilizers are not applied, the stolons which are supposed to show a high fertilizer response are not so widespread.

In spite of the difficulty to eliminate some fluctuation brought about by naked eye observation, the percentage of vegetational cover increases along with the growth of grasses. According to observation at harvest time, the average vegetational cover for the first year shows 59% for monthly cutting, 76% for bimonthly and 81% for trimonthly cutting. It reflects a remarkable increase in the amount of standing crop fresh weight. The bare land percentage does not show so significant difference among each cutting period chiefly because the vegetational condition is kept very compact, resistant to the effect of cutting.

According to data obtained during the first year, two conspicuous facts are revealed ; the seasonal change of productivity and the influence of cutting frequency on native grass production. From the observation of the monthly cutting plots, per hectare fresh weight production for each month can be seen ranging from 270 kg. to 1,880 kg. with a couple of short-period recesses during the first one year, which possibly results from the changing amount of precipitation. Likewise the bimonthly as well as trimonthly cutting plots show similar fluctuation as shown in Table 13.

It is interesting to note that the monthly cutting plots result in the poorest annual production as much as 11,530 kg./ha., indicating that too frequent harvests give unfavorable impact on the growth of native grasses. As is generally known, chloroplasts contained in the leaf produce their own nutritive substances by way of photosynthesis. But when those parts are removed, plants have to initiate their regrowth at the cost of nutrition stored in the root parts, so that the repeated removal of leaves in the early stage of its growth before the necessary nutritive accumulation would hamper plant regeneration, decreasing the total amount of annual production as a result. In addition, continuous grazing inevitably causes repeated trampling that brings about vegetational damage and retarded growth.

The annual production in the bimonthly and trimonthly cutting plots amounts to 14,670 kg./ha., 16,580 kg./ha., each of which attaining the increase rates of 27% and 44% respectively. A rapid lignification of the grasses and the resulting decrease in palatability are reportedly usual problems for tropical grasses. However, under such infertile grassland condition, native grasses grow rather slowly bringing about less significant lignification problem within the proposed trimonthly cutting interval. Consequently the rotational grazing system with an interval of three or four months seems to be adequate to the native grassland in this region.

The fluctuating seasonal grass production is one of the problems in the formation of rotational grazing calendar. According to the experimental data, the standing crops after three months' resting period range from 2,390 kg./ha. to 7,200 kg./ha. In order to cope with this problem, either a preparation of some spare paddock or introduction of high-yielding forage crop is necessary. An example of calculation on the relation between carrying capacity and required grassland acreage is proposed as shown on Table 14. In this calculation the available grass rate is assumed to be 85%, and the conception of 15% rate of damage is introduced as well to make up for the vegetational damage and retarded growth caused by grazing and trampling. The cattle are supposed to take fresh grass as much as 15% of their body weight per day. Four paddocks are necessary to complete 3 months' interval rotational grazing system throughout the year. The cattle herd is thus kept in each paddock for one month after 3 months' resting period. One additional spare paddock is prepared to meet the grass shortage resulting from seasonal unbalanced grass production. In conclusion, 144 ha. native grassland divided into 5 paddocks can support 100 head of adult cattle herd with the implementation of successful rotational grazing. But in consideration of poorer vegetations brought about by such unfavorable factors as bad topography, cattle trails, critical land condition generally seen in actual grasslands, more than 200 ha. seems to be required in case of practical grazing. It would require more grassland to keep the same number of cattle if such intensive ways are not introduced.

Table 13. Native Grass Production with Different Cutting Intervals

Cut-interval	Monthly			Bimonthly			Trimonthly		
Item / Date	F.G.W. (kg/ha)	L.H. (cm)	V.C (%)	F.G.W. (kg/ha)	L.H. (cm)	V.C. (%)	F.G.W. (kg/ha)	L.H. (cm)	V.C. (%)
1980 Oct. 15	-	-	-	-	-	-	-	-	-
Nov. 19	1,200	26	52	-	-	-	-	-	-
Dec. 18	1,660	27	68	2,920	39	73	-	-	-
1981 Jan. 15	320	27	52	-	-	-	2,390	40	73
Feb. 18	580	19	56	1,230	37	70	-	-	-
Mar. 18	280	21	38	-	-	-	-	-	-
Apr. 15	1,240	23	58	2,430	35	67	4,380	34	78
May 13	1,880	25	72	-	-	-	-	-	-
June 9	960	23	67	3,460	40	73	-	-	-
July 20	1,590	23	60	-	-	-	7,200	48	83
Aug. 18	1,000	32	70	2,700	41	87	-	-	-
Sep. 16	550	21	50	-	-	-	-	-	-
Oct. 17	270	17	67	1,930	28	88	2,610	39	68
Sub-total	11,530	-	-	14,670	-	-	16,580	-	-
(Ratio)	(1,00)			(1.27)			(1.44)		
M e a n	961	24	59	2,445	37	76	4,145	40	81
Nov. 10	670	21	60	-	-	-	-	-	-
Dec. 14	1,950	20	78	3,870	34	85	-	-	-
1982 Jan. 13	510	24	47	-	-	-	3,390	41	73
Feb. 18	760	19	50	1,700	33	72	-	-	-
Mar. 16	830	18	48	-	-	-	-	-	-
Apr. 13	690	25	60	2,300	32	75	3,450	40	78
Sub-total	5,410	-	-	7,670	-	-	6,840	-	-
(Ratio)	(1.00)			(1.45)			(1.26)		
M e a n	902	21	57	2,623	33	77	3,420	41	76

F.G.W. = fresh grass weight (kg./ha.)
L.H. = maximum leaf height (cm.)
V.C. = vegetational cover (%).

Table 14. Example of Calculation for Rotational Grazing

Item	Figure		Basis for Calculation.
Grass production	16,580 kg/ha. year	(1)	Table 13
Available grass rate	0.85	(2)	Assumption
Rate of damage	0.15	(3)	ditto
Rate of intake	0.72	(4)	(2)x{1-(3)}
Available grass	11,938 kg/ha. year	(5)	(1) x (4)
Cattle weight	250 kg.	(6)	Assumption
Daily grass intake	37.5 kg/day	(7)	(6) x 0.15
Annual grass intake	13,688 kg/head year	(8)	(7) x 365
Necessary grassland	1.15 ha/head	(9)	(8) ÷ (5)
Grassland for 100 head	115 ha.	(10)	(9) x 100
Spare grassland	29 ha.	(11)	(10) x 0.25
Total grassland	144 ha.	(12)	(10) + (11)
Number of paddock	5	(13)	4 + 1
Size of each paddock	29 ha.	(14)	(12) ÷ (13)

IV-3-3. Forage Crop Cultivation.

(1). Introduction :

It is quite a natural policy to introduce forage crops of high productivity aiming at an increased production of livestock. As a matter of fact, those forage crops or pasture plants are rather easier to be cultivated with success than other food crops from the technological point of view. But what should be seriously studied before the practical grassland improvement scheme is the economic advantages and disadvantages as result of such forage crop cultivation. Productivity, palatability, regenerating vigor, persistence, disease-and-insect resistence, seed production, method of propagation, etc. are among these important characteristics for successful cultivation. The fertilizer application is indispensable to support continuous growth; however, the effective use of fertilizers under different conditions should also be examined. Although a wide-ranged and detailed experiment is difficult to be performed because of the limitations in materials and labor, a number of general problems in case of the forage crop introduction into the remote mountain districts are pointed out on the basis of the data obtained from the simple experiment.

(2). M e t h o d s :

Location : The project site is a plot of land where the night paddock was once installed for an uncertain period. The soil is fertile enough with the accumulation of dung (Refer to Table 7,F). As regards prior vegetation, a kind of the Chrysanthemum species and other weeds are rampant.

Preparations : After the removal of weeds, careful plowing and harrowing are done before the start of the experiment.

Treatments : Pasture plants introduced : 6 species of Legumes and 2 grass species.

Those are : a). Stylosanthes hamata
b). Glycine wightii
c). Desmodium intortum
d). Macrotyloma axillare
e). Stylosanthes guianensis
f). Desmodium uncinatum
g). Panicum maximum
h). Melinis minutiflora.

a) to f) are Legumes ; g - h are grass species.

Origin of the seeds : The above-mentioned seeds are brought by one of the staff of CSIRO from Australia in May 1979 and preserved by the Animal Husbandry Department of the Hasanuddin University in Ujung Pandang.

Date of sowing : February 13, 1980.

Scale of the testing bed : 1 m x 2 m = 2 m2.

Sowing method : Drill sowing with the width of one meter.

Quantity of seeding : a) - g) : 6 g/m2.
h) : 2 g/m2.

Fertilizer application :
Basic fertilizer : compound chemical N:P:K = 13:13:13;
a) - f) : 50 g/m2. ; g) - h) : 100 g/m2.
Additional fertilizer : none.

S u r v e y : Plant growth, seed production, regrowth, trampling resistance, insect resistance,etc. are observed.

(3). Results and Discussion :

As a result of the small experiment, the traits of legumes (herbages) manifest themselves to be very contrastive to those of the creeping type grass species. All the Legumes are regarded as unfit for the grassland improvement in this region because of their inherent lack of trampling resistance and poor regrowth. Seed production capacity varies from species to species but as a general tendency, seed production is not so promising in this region for lack of distinct seasonal cycle. Moreover, the soil quality characterized by its considerably low pH and phosphorus deficiency is unsuitable for the growth of Legumes.

While Panicum maximum is unsuccessful in germination, Melinis minutiflora shows a typical growth characteristic of creeping type grasses. Although slow in growth at the early stage, Melinis minutiflora keeps spreading in all directions with its creeping stalks until it covers an area of nearly 6 x 6 m2 within six months since seeding. It can also be propagated by cuttings, which show strong drought resistance, and then gradually invades other vegetational communities. To the contrast of those Legumes diminishing with the impact of occasional grazing, weed intrusion, or drought, the vigorous growth of creeping type grass is observed to be an important trait for the extensive way of grassland improvement, and additional experiment on other species of this type is expected.

Table 15. Height of the Introduced Pasture Plants

(cm.)

Date \ Species		a	b	c	d	e	f	g	h
1980 Feb. 13		seeding							
Mar. 12	a)	2	7	2	6	4	4	-	-
Apr. 10	a)	16	55	35	75	25	38	-	33
May 26	Intrusion of Bali cattle to the testing site								
July 26	a)	37	106	111	140	70	100	-	84
Sep. 2	a)	53	126	135	95	105	150	-	124
	b)	30	50	97	76	96	45	-	85
Dec. 4	a)	30	80	86	115	59	-	-	120
	b)	26	66	80	97	50	-	-	94

a) : Maximum plant height

b) : Community height.

Brief comments on each cultivated species :

a). Stylosanthes hamata (cv. Verano).

This species originating from coastal districts of the West Indies and their vicinities result in the poorest growth among those tested, presumably because the soil quality or the native nodule bacteria is not agreeable. Being an annual variety, the vegetation needs to be renovated with spontaneously dropping seeds, but no ripe seed could be found despite abundant flowers. As a consequence , Stylosanthes hamata gradually loses its vigor and is replaced by plants of other species.

b). Glycine wightii (Neonotonia wightii) (cv. Malawi).

This perennial climbing herb shows a fairly good germination rate and early growth, reminding that a hard seed treatment was conducted prior to seed distribution. This species with its wide, ovate to elliptic leaflets of high nutritive value seems to exhibit satisfactory production under intensive cultivation. The leaflets wither slightly at times of drought, yet resistant enough under the given circumstances. Glycine wightii shows the highest palatability among those tested, and it was grazed most heavily by Bali cattle intruding into the testing site on May 26, 1980. Seed production was successful except for those affected by mold. Some of the leaflets were damaged by insects.

c). Desmodium intortum (cv. Greenleaf).

This perennial herb, scandent to develop tall dense stands, was vigorous enough to ensure high productivity. The ascending stems grew to cover the neighboring plants. Seed production was possible, but seed collection was difficult because of the fragile pods liable to drop after full maturity.

d). Macrotyloma axillare (= Dolichos axillaris) (cv. Archer).

This climbing perennial herb was vigorous enough to grow as if covering other plants. It is reported that in spite of its good palatability, animals have to be accustomed to it. As a matter of fact, the herb was grazed slightly by the intruding cattle. It can produce good deal of seed, and the flowering lasts for a considerable period which helps the native farmers in collecting the seeds successfully.

e). Stylosanthes guianensis (cv. Cook).

This species is remarkable in its hardiness and adaptability to various climatic and soil conditions, and shows a persistent growth at the testing site in spite of the slow initial growth. It seems to be resistant against a number of unfavorable factors such as drought, pests, diseases, etc. But its quality is not so favorable because of the large proportion of stems and oxalate content, and cattle need to be accustomed to Stylosanthes guianensis which is slightly aromatic. Numereous flowers developed and flowering lasted for a long time. The position of flowers mixed with ferbage and shedding nature of mature seed make the seed harvest rather difficult.

f). Desmodium uncinatum (cv. Silverleaf).

Presumably due to the lack of hard seed treatment and Rhizobium inoculation, the germination rate was very poor, and the plant was less vigorous until it perished completely as of December 4, 1980. Considering the trailing stems which usually grow very long, this species may not be resistant against trampling and heavy grazing.

g). Panicum maximum (cv. Makueni).

As is generally reported, the germination rate is extremely low, and no evidence of germination could be observed in this cultivation test. The poor storage condition also seems to have an adverse effect on the seed quality.

h). Melinis minutiflora.

Although rather slow in the early stage of growth, Melinis minutiflora exhibited a persistant competitive vigor and agressive nature with its creeping stalks spread over in all directions. It could be propagated successfully through its cutting (thus vegetatively) and grew very well even in acid and poor soil of the project site without fertilizer application. As growth progresses the basal leaves die out, but the young agressive parts keep attaining a good ground cover which offers some contribution for soil conservation on steep slopes with poor soil. Melinis minutiflora resulted in less palatability as compared with Brachiaria decumbens probably due to the sticky, smelling substance exuded from its hairy leaves. Flowering was good enough, but seed setting has not been checked yet. Propagation with cuttings might be more convenient to the situation of the project site.

IV-3-4. Nursery Bed and Grassland Improvement Technology.

(1) Nursery Bed :

As is proved with the forage crop cultivation test, creeping type grasses are, for the vigorous, agressive nature and the resistance against grazing and trampling, most suitable to be introduced for the improvement of sloping grasslands in this region. Another merit of creeping grasses is that they can easily be propagated vegetatively by cuttings. For the supply of these cuttings, the nursery bed was constructed at the plot of land where the night paddock was once installed and the soil is fertile enough with the accumulation of dungs. Brachiaria decumbens and Pennisetum purpureum were introduced from the Forage Crop Center of Kabupaten Enrekang.

Table 16. Comparative Growth

D a t e	a	b	c	d	e	f	g	h
1980 Feb. 13	S e e d i n g							
Mar. 12	1	5	2	2	2	1	0	0
Apr. 10	2	5	3	2	3	1	0	1
May 26	Intrusion of Bali cattle to the testing site							
July 26	4	5	5	5	5	2	0	5
Sept. 2	3	5	5	5	5	1	0	5
Dec. 4	2	4	4	5	5	0	0	5

Note : Better ——5 4 3 2 1—— Worse.

Table 17. Seed Production and Other Qualities

	a	b	c	d	e	f	g	h
Seed quantity	?	0	0	△	0	X	–	?
Seed dropping	?	0	X	0	0	X	–	?
Seed quality	?	△	0	0	0	?	–	?
Seed production	X	△	△	0	0	X	–	?
Plant vigor	X	0	0	0	0	X	–	0
R e g r o w t h	X	△	△	△	△	X	–	0
Trampling resistance	X	X	X	X	X	X	–	△
Insect resistance	0	△	△	0	0	0	–	0

0 = Excellent; △ = Medium; X = poor; ? = unknown.

1). Brachiaria decumbens

Brachiaria decumbens originated from tropical East Africa shows good performance in Indonesia and becomes very popular. It was introduced to the nursery bed in June, 1980 in order to supply cuttings for the Grassland Improvement. About 70% of the planted cuttings withered up because of the drought and the others were saved by watering. But those survived grew vigorously, being supported with fertile soil and occasional rains, and at last covered all the vacant land spreading in all direction with the rooting nodes. The flowering stems generally grew 120 - 150 cm. tall and bare land ranged between 70 and 90%, but with the impact of grazing and trampling, grass height as well as bare land percentage decreased. The flowers were profusely formed but no seed was obtained. The nursery bed suffers the intrusion of cattle from time to time, which indicates high palatability of Brachiaria decumbens. The fresh weight productivity of Brachiaria decumbens is as shown in Table 18.

Table 18. Productivity of Brachiaria decumbens

(Fresh weight ton/ha.)

Date \ Treatment	Non :	Urea :	NPK :
1981, March 19 △	(48.4)	(55.1)	(54.4)
April 17	28.0	37.8	23.5
May 13	18.0	13.0	17.0
June 9 △	21.3	18.5	18.3
July 20	31.5	27.5	25.3
Sept. 16 △	15.3	21.8	14.3
Oct. 19	13.5	11.0	6.5
Dec. 14 △	39.5	30.0	24.0
1982, Feb. 18	24.0	19.0	12.5
April 13	41.8	25.8	25.0
Total	232.9	194.4	166.4

△ : Fertilizer application

( ): Initial standing crop weight

Non : No fertilizer application

Urea : Urea (N = 46%) 300 kg./ha./year.

NPK : N : P : K = 13:13:13 1,000 kg./ha./year.

Application of Urea and NPK brought about no increase in productivity probably because the soil was fertile enough to support the full growth of the grass. And the different productivity of each treatment was chiefly derived from the different number of bunch included in each testing plot.

2). Pennisetum purpureum

Pennisetum purpureum originated from tropical Africa is valued in Indonesia for its high herbage yields, competitive vigor and persistence, good herbage quality, etc. It was introduced to the nursery vegetatively by stem cuttings in June 1980. Withstanding the considerable drought the cuttings vigorously developed roots at the nodes and showed, being supported with fertile soil, suprising growth that reached 250 cm. high in 3 months and 500 cm. for final height. But those sticks introduced to the native grassland with poor soil could show reduced vigor and production. Flowers were formed 3 months after planting but no mature seed was produced. Considering its characteristics, Pennisetum purpureum is suitable for intensive cultivation when and where much dung is available.

(2). Grassland Improvement Technology :

The greatest disadvantage in the grassland improvement scheme at the project site is its bad topography. It is inevitable to cultivate the land for the introduction of forages, however, the overall cultivation, in many cases, induces serious erosion and succeeding land devastation. In order to evade such a dilemma, the strip cultivation method was adopted. The native grassland was plowed horizontally by human powers with the width of one meter and the interval of five meters. The planted cuttings of Brachiaria decumbens suffered damages by drought and intrusion of water buffaloes, which indicates that the timely planting, complete protection against livestock and the acceleration of growth with fertilizer application are essential for the steady growth of cuttings and early establishment of vegetation.

One of the biggest problems of this strip cultivation method is that improved area is limited to only one sixth of the land and the other parts remain unchanged, consequently the production increase as a whole is rather low. Moreover, when forages are cultivated side by side with native grasses, forages are usually preferred to be grazed and suffer greater damage than the native ones. Considering those problems, the maintenance of the improved grassland of strip cultivation method should be conducted with careful and appropriate rotational grazing system and sufficient fertilizer application to stimulate forage regrowth after grazing. From the economical point of view, such an intensive way of forage introduction is feasible only where the soil is fertile enough or when abundant manure can be obtained. If such a strip cultivation is successful, forage should also be additionally introduced between those strips in order to increase the improved area, thus finally covering all the land with forages.

IV-3-5. Useful Trees for Animal Husbandry.

(1). Fence Construction :

Fence is a symbol of the rench. It is not only one of the essential facilities of the ranch, but also the most vulnerable part of it. In the wet tropical regions, the wood stakes are liable to get rot within several months because of hot and humid climate. On the contrary, if iron stakes or high quality woods are used, the burden of capital investment on those precious substances is too great. As substitute for these fence construction method, the branches of Lannea grandis, locally called " Tamate " or " Java tree ", which can sprout roots and shoots out of planted stakes and grow well were intoduced as generally seen all over Indonesia. About 80 to 90% of planted Tamate stakes continued to live and grow successfully. Dormancy and defoliation were observed, i.e. it took one to four months to start growing after planting the stakes, as well as leaves fell between October 1980 and January 1981. The growth of Tamate was less vigorous compared with those introduced to the other regions, which would be attributed to the tight and sterile soil and high altitude. Tamate stakes introduced to the plowed soil showed better growth than those planted straight into the hole.

(2). Useful Trees for Grassland and Livestock Production :

Introduction of useful trees, especially leguminous trees, to the grassland is very significant in various ways. First of all, afforestation to the denuded land area is important for erosion control, and the introduction of leguminous trees might well help soil enrichment by fixing aerial nitrogen with the root nodule bacteria. As well as leaves of those species contain much nitrogen, potassium and phosphorus, those of which improve the soil quality as the green manure. Furthermore, legume leaves, quite palatable with high protein content, can supply nutritious fodders for livestock. When grown big, trees can also offer shades to the animals. Three popular species of leguminous trees were tried to be introduced into the project site, but in many cases, the attempts were interrupted by various factors.

1). Leucaena leucocephala (Lamtoro) :

This species originated from Central America and has been propagated throughout the tropical and subtropical regions for its high procreative power, rapid growth and volume increment even in infertile land, diversity of use, etc. Contrary to expectation, the planted seedlings of Lamtoro show only a little growth, which presumably attributed to its affinity for the neutral to alkalic soils (pH 7.0 - 8.2), while the soil pH at the project site is around 4.0. High altitude might also affect negatively on the growth. It is reported that the leaves of Lamtoro contains a toxic alkaloid substance called mimosine which causes depilation for livestock.

2). Sesbania grandiflora (Turi) :

Turi is well known for its rapid growth and procreative power. It bears long pendulous pods, which are used for livestock fodder, and is often planted as shadetrees. Some of the Turi trees that were introduced to the nursery bed by seed showed good result, while the majority of others were hampered by grasses covering over the seedlings. Those introduced to the fertile land are sometimes at the mercy of wild hogs that haunt at night in search for foods. Seed introduced directly to the grassland did not grow successfully.

3). <u>Glyricidia maculata</u> (Gamal) ;

Gamal is utilized in various ways such as afforestation, soil enrichment, shadetrees, etc. for its convenience to be introduced by cuttings. Those introduced to the nursery bed successfully sprouted shoots, meanwhile many of them were damaged by the overwhelming vegetational power of <u>Brachiaria decumbens</u>. Newly planted trees are, in many cases, competitive with the existing vegetation, especially with grasses which can grow faster than trees, thus the growth of trees are hampered especially at the initial stage. Full plowing should be preceded in introducing trees to the grassland, otherwise they will not grow satisfactorily. Damage caused by grazing livestock is also one of the biggest problems that interrupt afforestation to the grassland, and a long period of time is required before the establishment of the introduced trees.

IV-3-6. Grazing Management of Bali cattle.

(1). Present Condition and Problems :

The present herd is derived from 45 females and 5 males of 1.5 year old Bali cattle introduced into the 500 ha. pasture of the project site in August 1975. The number of animals until October 1978 has been checked and reported by the former short-term expert on Grassland Improvement, but from 1979 on, the number of cattle has not been checked exactly. So we tried to estimate the number during the successive years on the base of previous data such as shown in Table 19. Calculation was made as 50 per cent in calf crop and calf matured at about 3 years' age. According to this estimation, total number of cattle comes to 153 heads in 1981. Although we tried to measure body weight of all animals, as well as to check the exact number, individual health condition, pregnant or not, and so on, we could weigh 12 cows and one bull because of the imperfect collecting yard, and moreover, the cattle were unaccustomed to being weighed.

Results of this investigation are shown in Table 20. The actual number of cattle at the project site in November 1981 is smaller by 16 heads as compared with the estimated number, suggesting that calf crop has been changing below 50 per cent for three years. There is particularly a big difference in the number of bulls between the actual and the estimated ones. Body weight of cows and bulls of the project site are approximately 200 kg.and 25 respectively, both of which seems to be less than that of the ordinary ones. Although it is said that the native animal is less troubled by flies because it can twitch any spot of its skin as the fly lands, Bali cattle on this pasture seem to be disturbed and stressed by small stable flies, particularly around their eyes. And eye disease is marked in older cows. Cause of the poor reproductive performance and the small size of mature animals at the project site are suggested as follows :

i). Reduction of reproductive activity in both the male and the female due to undernutrition;

ii). Reduction of reproductive efficiency by the progress of inbreeding due to no introduction of new bulls;

iii). High rate of calf mortality due to the lower milk yield of dams;

iv). Breeding age : when the heifer is mated and pregnant before she reaches mature size, she will not able to grow bigger and her calf would be smaller;

v). Retarded growth of calves by lower milk yield of dams;

vi). Increased energy loss by over-exercise (loads) : if the paddock is large and in bad condition, cattle have to walk a long, distance in order to take in sufficient amounts of grasses, and calves would certainly walk the same distance as the dams do because they heel their dams.

i), iii) and v) of these problems will be solved to some extent by the improvement of natural grasslands. But at present only 3 paddocks are equipped with fence and improved pasture by strip cultivation is not established yet, for which reason rotational grazing remains impractised.

Other matters to be noted about range condition are as follows :

i). Extension of denudation; this tendency is conspicuous at the camping site of the cattle herd;

ii). Luxuriant growth of shrubs and bracken in some parts of the paddocks;

iii). Absence of shade trees in the pasture;

iv). Erosion at the cattle tracks, particularly on steep slopes.

Maximum production from a given range unit is dependent upon prop-per management and use of the resources.

Of fundamental importance are :

(a). Balancing numbers of animals with forage resources;

(b). Grazing at the correot season of the year : and

(c). Securing proper distribution of livestock over the range.

The annual production of fresh native grasses is estimated at 13 - 16 ton per ha. by plot sampling method, but the average of this range is considered to be about 8 ton per ha. Calculation is made to estimate how many cattle can be kept in this range of 500 ha. as follows :

$$\frac{500 \text{ ha.} \times 8 \text{ t.} \times 75\%}{300 \text{ kg.} \times 13\% \times 365 \text{ days}} = 210 \text{ heads.}$$

Utility rate of grasses depends on the stocking rate. Of course it is difficult to determine the correct grazing capacity of range land because range forage utilized or damaged by cattle can neither be weighed nor measured accurately. So the range manager has to judge the proper livestock number by soil changes, vegetation changes and livestock condition, and the manager should avoid heavy grazing or overgrazing.

(2). Technical Counterplan to Increase Productivity :

1). Herd composition, selection and culling :

It is said that the project site is intended for the breeding stock ranch of Bali cattle in South Sulawesi in the near future. For this reason and also to increase reproductive efficiency, the following countermeasures are necessary :

i). Importance of records and identification of livestock :
It is important to weigh and check the health condition monthly or bimonthly. According to the records such as weight gain, calving interval, progeny's growth rate and so on, unwanted animals have to be culled out. It is desirable to arrange the collecting yard equipped with strong timbers in order to weigh and check successfully.

ii). Introduction of good quality bulls :
It is necessary to introduce good quality bulls every 4 or 5 years because in the case of mating in pasture, exhaustion of bulls is great and inbreeding must be prevented. Male : female ratio varies with paddock size and topography but, 1 : 20 - 30 is deemed proper.

iii). Seasonal breeding :

It becomes easier to manage the cattle herd if the breeding season is constant, that is, it is possible to put the cows and off-springs into good pasture and to wean calves at a time. With such a control, accidents at calving in both dams and calves may be reduced. Furthermore, it may contribute to a decline of calf mortality because cows can take in sufficient amount of grasses and produce more milk. To conduct seasonal breeding, bulls are put into a paddock with cows during approximately three months and during the other periods bulls are kept separately from the cow herd. The start of breeding should be determined by desirable calving season.

iv). Separation of the weaned calves :

Weaned calves, e.g. yearling males and heifers, have to be kept separately from the cow herd, particularly heifers should not be bred until they reach mature size.

Table 19. Changes in the number of Cattle at the Project Site in Enrekang.

Year	Bull	Male Yearling	Bull Calf	Cow	Heifer	Cow Calf	Total
1975	0	5	0	0	45	0	50
1976	5	0	2	45	0	1	53
1977	5	2	15	45	1	8	76
1978	2*	17	11*	37*	9	8	84
1979**	4	26	10	38	16	9	107
1980**	19	21	12	46	17	11	126
1981**	30	22	14	54	20	13	153

* 2 bull calves and 4 cows died, and 3 bulls and 4 cows were transferred to other places.

** Cattle number from 1979 to 1981 were estimated as 50% in calf crops from previous data.

IV-4. Possibilities and Points at Issue Regarding the Animal Husbandry in Pasture.

IV-4-1. Merits of Animal Husbandry in Pasture :

The importance of animal husbandry as the means of production of animal protein which occupies the essential element of human nutrition is widely recognized. Except swine and poultry, domestic animals such as cattle, water buffaloes, sheep and goats are all belong to the herbivorous animals whose system of digestion is quite different from that of other carnivorous or omnivorous animals.

Those herbivorous animals have four compartments of stomach, i.e. rumen, reticulum, omasum, abomasum, and be symbolically named ruminants for the large rumen which accounts for about 70% of abdominal cavity in volume. The digestive system of the ruminants is characterized by the operation of bacteria and protozoa which live in the rumen and act upon grazed forages usually abundant in cellulose, consequently produce volatile fatty acid to be an main energy source for the animals. These micro-organisms also play important roles in analysis and synthesis of protein, decomposition of fat, production of vitamines, etc. For this nutritive advantage, the herbivorous animals of this group can convert such fibrous forages as men can not eat directly into animal protein, the indispensable element of human nutrition. They are appropriate for their docility to be used as farm animals that help to cultivate land, or tract carts, and their excrements is important as manure to increase soil fertility.

Looking over the different type animal industries in each regions, the management systems are greatly adapted to natural and social conditions of each region. Nomadic tribes of the Central Asia, where dry climate dominates, totally depend upon their animals and continue to wander round the vast squares generally known as the stepps in search for rather scanty grasses. In the prairies of the United States, the pampas of South America as well as Australian Continent, the large scale modern animal industries are conducted taking advantage of the vast plain grassland and suitable climatic condition for animal production. On the contrary, in a country like Japan which is already industrialized but scarce in suitable land, the animal industry is obliged to depend upon concentrates from abroad.

The characteristics and problems of Indonesian animal industry can be cleared up by comparing with that of the other regions of the world and analizing how animal husbandry is carried out successfully to match the given circumstances. As for natural condition, most of its territory belongs to humid tropical zone symbolized with its vast virgin rain forests But in the vicinity of agricultural land area, fresh native grasses can be obtained almost all the year round without any care to speak of. The fact that livestock can be raised without any stored feeds or any special investments on forage cultivation is really a great and surprising advantage of this region. From the aspect of social condition, peasant farmers occupy the majority of the rural population, and livestock is raised in the framework of the small-scale mixed farm household. Livestock is usually cared by children or unemployed family members. In such a situation, animal husbandry is not necessarily focused on meat production alone, but have multilateral purposes for rural communities. Consequently, productivity of labor being suppressed to be very low, livestock can be raised to a considerable degree without any device and capital, and yet contribute in various ways to farm economy. It is significant that a fairly good number of livestock is actually kept throughout Indonesia, and the present agricultural system will continue to dominate in the foreseeable future.

Table 20. Results of Investigation at the Project Site

(November 1981)

	Number of Animals	(pregnant)	Body Weight
C o w	56	(6)	200.0 kg. (n=12)
Heifer	16		
Cow calf	12		
B u l l	21		250.0 kg. (n= 1)
Yearling male	15		
Bull calf	15		
T o t a l	135		

IV-4-2. Limits and Points at Issue :

Such a discussion is probable to be carried on as saying that the forest-covered humid tropics with its intense solar energy and abundant water supply possesses infinite possibilities for plant production. But the experts of much experience in the tropical region can recognize that in spite of many favored factors, the vegetational production in this region is quite limited. As a matter of fact, it is the poor quality of the soil that hamper the plant growth. The high temperature and sudden copious rainfall are liable to decompose organic matter and fertilizer quickly and mineral substances are easily leached away. Consequently, the soil is generally turned to be solid, acid, and poor in minerals and organic matter. It is widely known that deforestated areas suffer serious erosion caused by squally rain and remain devastated.

The plant respiration accelerated by high temperature that lasts even at night decreases the accumulation of vegetational production as a result. As a matter of fact, the low level of per acreage agricultural production in the humid tropics cannot necessarily be attributed to the lack of high technology and materials for cultivation. Taking the example of short-term crops as forages, the temperate zone summer season takes more advantage than the humid tropics in amount or duration of solar radiation, soil fertility, temperature drop during the night, etc. Moreover, forage quality deterioration like lignification is conspicuous in tropical grasses. In this way, the natural factor seemingly favorable for plant growth has its own limitations and it should be recognized that much effort is required to overcome such limitations and disadvantage.

The heat and moisture that cause much harm to animals is another important factor for livestock farming. Cattle scattered throughout the tropical region is generally small-sized and slow growing in comparison with that of the temperate region, but this characteristic is more or less related to the ability of resistance against constant heat, intense solar radiation, low quality forage, interior and exterior parasites, malignant diseases, etc. On the contrary, European type cattle of superior quality introduced into the humid tropics reportedly result in poor productivity being unsuccessful to perform its potential genetic traits. Selection of suitable breed of cattle to each natural environment should be noticed as a decisive factor in this context.

Bali cattle recorded sharp increase in number since the introduction into South Sulawesi, showing good adaptability to the circumstances with its ability to thrive on feed of very low nutritive value, high fertility, resistance against rough management; but is not suited for meat production because of its small body size and poor daily weight gain. Javanese people prefer to raise Ongole cattle of Zebu type for its sturdiness, docility, and heat tolerance, but this breed seems to be low in fertility rate. In recent years, the Indonesian government has been importing many Brahman Cross breeds of different variety from Australia for the purpose of cattle quality improvement, however their ability of acclimatization to the humid tropics is still thought to be uncertain. In such a situation more observation and research works are required before the determination of suitable cattle breeds, and for the time being, each breed should be raised case by case to meet the demand of different purposes.

It goes without saying that livestock industry structure in each country is closely related to its social conditions which regulate production mechanism and demand formation. As is repeatedly pointed out, the purpose of animal husbandry in Indonesian society is very numerous and complex. Since animals are source of draft as well as a kind of savings for many peasant farmers, livestock farming is not necessarily focused on meat production alone. In case of draft use, cattle is expected to be hardy enough to toil up in spite of poor feed, while performance of daily gain and fertility is the important factor for beef type cattle, both of which are contradicting each other. It is worth keeping even an aged cattle that neither grows nor reproduces calves when it is regarted as insurance against urgent and unexpected expenditure. Consequently, even if investment of any kind is done for increased forage production, economic return can hardly be expected when the forage is used up only to keep the cattle alive without any increase in body weight. But for industrial development and succeeding structual change of whole society, it might be difficult to organize the livestock industry that can produce enough economic efficiency through meat production alone.

IV-4-3. Course of Future Development :

(1). Necessary Conditions for Forages Crop Cultivation :

Forage crops are originally so vigorous in their growth that there is not so many problem as far as cultivation technology is concerned. It is rather economic condition than technology that stipulates livestock farming, i.e. wather forage production can bring about some benefits, or whether forage is the keystone of whole management system. The followings are some examples of forage introduction ever been observed in Indonesia.

1). Utilization of Forages Introduced for the Other Purposes.

Forage crops are in some cases introduced to cover bare land areas for erosion control. But such a land is generally stepp sloped and grazing of livestock is not fitted from the view of land conservation, so that forages are necessarily cut and carried by human power to feed livestock. In consequence, labor-consuming farming of this type seems to be limited to Java Island where intensive farming is inevitable because of the high population density. In case legume trees are introduced for the purpose of land fertilization, companion cropping like shadetrees, afforestation, etc. the leaflets and pods can be supplied to livestock as feeds. Legume trees are superior to herbages in persistance, soil conservation, multiple utilization, three-dimension space occupation, etc.

2). Forage Cultivation with Abundant Compost :

As is repeatedly emphasized, forage cultivation consumes a large quantity of fertilizer. But it is quite reasonable if manure discharged by animals can be utilized for forage production within the ecological recycling system of substances. Abundant manure is accumulated in such places as the night paddock of our project site, the barn-side of quarantine or cattle fattening, abattoirs, etc. and forage cultivation is significant in the sense of waste substance treatment.

3). Cases of forage Cultivation is Indispensable :

Systematic forage crop cultivation is indispensable in case of special situations as follows : to support the effective management of feeding dairy cattle, foreign breeds of European origin, wearing calves, etc., in modern animal husbandry undertakings; to prepare forage stock for large heads of livestock during the long-term dry season to feed cattle, during the course of inter-insular transportation, etc.

(2). Basic Policy for Future Development :

Over the past ten years, Indonesia has remarkably achieved industrial as well as social progress. As regards agriculture, rice production has been boosted until it exceeds 20 million tons in 1981. But despite this development in the other sector and farmer's enthusiasm for cattle farming, the number of herbivorous domestic animals has not increased, and as a result of rapid increase in human population, the number of livestock per capita rather decreased. Export of livestock actually ceased in 1978. This fact implies that the number of livestock is strongly regulated by the amount of feed provided, nevertheless increased acquisition of additional feed has not been conducted successfully. Considering that a large amount of feed, obtainable very economically, is required, the future governmental policy should put strees on the development and utilization of abundant natural grass resources scattered over the vast expanse of outer territories, and at the same time farm management system should be intensified from the aspect of efficient meat production.

1). Exploitation of New Natural Grass Resources :

In Indonesian outer territories, wide areas of grasslands which still remain intact wait for exploitation. Among those are Nusa Tenggara which is suitable for large-scale commercial livestock industry, grassland around each transmigration project site, etc. The credit system for cattle propagation, the so-called " Sumba Contract ", is expected to be some drive to stimulate farmers, especially transmigrants, in their attempt to raise their own cattle for the use of their farm management. Historically, Indonesian people had little experience of large scale livestock management which can be seen in the American and Australian Continent. For that reason, transmigrants lack the knowledge of how to make use of the vacant natural grassland lying with much potentialities. Well organized governmental leadership and farmer's enterprising spirit are needed to draw profit out of such natural resources of Indonesia.

2). Intensification of Livestock Management :

Although fundamental policies like disease control that need administrative support should be conducted by the government, it is the farmers' responsibility as to how they manage their own cattle in effective ways. Observing the transmigration project site in South-east Sulawesi we admired the cattle, mostly Ongole and Bali, to find them in superior quality, which owed to the diligent Javanese and Balinese people who provide shelter for cattle at the comfortable place, elaborately gather and supply them fresh agricultural by-products of high nutritive value and bathe them in the irrigation canal nearby. Such efforts mentioned above surely contribute much to better health as well as higher production of cattle. Lastly, emphasis should be laid not on the governmental subsidy policy for development, but on farmers' self-support and enterprising spirit to make their living better than ever.

IV-5. Operation Plan for the Grassland Improvement Pilot Test in Future.

IV-5-1. Construction Works :

(1). Completion of the C-type House.

The earliest completion of the C-type house is indispensable for the personnel in charge to secure their living.

(2). Completion of the Road.

The road construction should be carried out with great care and be completed as soon as possible in order to facilitate the transportation of both workers and materials.

(3). Construction of Paddocks.

All of the scheduled paddocks should be constructed for the promotion of grassland improvement and its effective use.

(4). Promotion of Grassland Improvement.

The trial of forage grass introduction by way of strip cultivation method should be continued. In case the improvement is successful, the forage grasses can also be introduced between those strips to expand the improved area.

(5). Prevention of Erosion.

In the critical areas where land erosion is feared to occur, grazing should be prohibited and trees or unpalatable vigorous grasses such as Molasses grass should be introduced.

IV-5-2. Management and Maintenance Works :

(1). Maintenance of the Fence.

The fence is one of the vulnerable parts of a ranch, so that much care should be taken of it. Continuous maintenance work is essential to keep effective control of the cattle herd.

(2). Maintenance of the Improved Grassland.

The improved grassland of high yielding forage grass is liable to be deteriorated by careless grazing and lack of proper management. Grazing should be conducted appropriately, and fertilizers should be applied to support further forage production.

(3). Maintenance of Machinery.

Proper use and periodic check are necessary to keep the machinery in operative condition. Sufficient budget should be allocated especially for the maintenance of the tractor and its attachments.

IV-5-3. Continuation of Research Works :

(1). Productivity of Native Grasslands and its Fertilizer Response.

Accumulation of data during a long period is important in ecological research works concerning grasslands. The expert expects the present activities to be followed by the counterparts.

(2). Introduction of Forage Crops.

Each species of forage crops has different characteristics and may be utilized in different ways in accordance to different conditions. Consequently, forage crop species should be collected as many as possible for experimental purpose.

(3). Introduction of Legumes.

Legumes should be introduced with systematic intensity for the purpose of land conservation, soil enrichment, forage supply, etc.

(4). Observation of the Cattle.

Such items as birth, death, diseases, parasites, etc. should be checked periodically.

IV-5-4. Cattle Management :

(1). Introduction of New Bulls.

If the present closed organization of the herd is to be continued, there will be a danger of inbreeding depression. New excellent bulls should be introduced without delay for the improvement of pure Bali cattle. High quality semen can also be introduced by means of artificial insemination.

(2). Reorganization of the Cattle Herd.

The aged, or low quality cattle will have to be culled, from the economic viewpoint. And the composition of the herd should be reorganized to fit the proper bull/cow ratio.

(3). Improvement in Feeding.

Cattle should be classified individually according to its physiological condition so as to fit efficient reproduction and nursing as well as to eliminate unnecessary burdens. The dams and their sucklings should be kept more intensively to avoid energy loss. Seasonal reproduction system is also worth practising for efficient and intensive cattle management.

REFERENCES

1). W. Veevers Carter, Nature Conservation in Indonesia, Indonesian Wildlife Fund, 1978.

2). Statistical Pocketbook of Indonesia, Central Bureau of Statistics 1968 - 1969, 1972 - 1973, 1979 - 1980.

3). Statistical Information on Indonesian Agriculture, German Agency for Technical Cooperation Ltd., 1978.

4). John Leake, The Livestock Industry, Bulletin of Indonesian Economics, 1979.

5). Annual Report of South Sulawesi Province Animal Husbandry Service, 1978 - 1979.

6). T. Matsukawa, Report on the Characteristics of Bali Cattle in South-Sulawesi, JICA ATA-140 project team, 1980.

7). T. Shimasu, et al, Cattle Feeding and Marketing in Indonesia, Banteng in South Sulawesi, Shokuhin Jukyu Kenkyu Center.

8). Annual Report of Kabupaten Enrekang Animal Husbandry Service, 1977 - 1978, 1979 - 1980.

9). J. Shoji, et al, Improvement of Grassland South Sulawesi Regional Agricultural Development Planning, ATA-140 Project, Final Report on Phase II, Volume II, JICA Project Team.

10). M. Tahir Djarre, et al, Laporan Analisa Tanah Area Grassland Improvement, ATA-140, pada ketinggian 1,000 m. diatas muka laut di Desa Buntu Barana, Kecamatan Alla, Kabupaten Enrekang, Propinsi Sulawesi Selatan, Proyek RADP/ATA-140, Sulawesi Selatan.

11). F. Harada, et al, Grassland Improvement Annual Progress Report of Phase III, RADP/ATA-140, JICA, 1980.

12). A.V. Bogdan, Tropical Pasture and Fodder Plants. Longman, 1977.

13). G. Williamson and W.J.A Payne, An Introduction to Animal Husbandry in the Tropics, Longman, 1978.

14). M. Noguchi, Forage Crops in the Tropics, JICA No. 133, 1981.

15). G. Nishikawa, Tropical Agriculture, Textbook of JICA Expert, 1975 - 1976.

16). T. Nagano, Present Situation and Problems of Animal Husbandry in the South-east Asian Region, Textbook for JICA Expert, 1976.

17). M. Naitoh, et al, " Chikusan Daijiten " Encyclopedia on Animal Industry, Yokendo, 1978.

18). K. Sakaguchi, Genus Leucaena and Giant Leucaena, Expert Bulletin Vol.2, No.3, Association of International Cooperation of Agriculture and Forestry.

CHAPTER V CITRUS IMPROVEMENT PILOT TEST

Hideo Miura
Dollah Mando

C o n t e n t s

CHAPTER V CITRUS IMPROVEMENT PILOT TEST.

V-1 Citrus Production in Indonesia.

V-1-1 Production outlook.

According to the statistics from the Directorate General of Food Crop Agriculture, the general condition of Citrus production in Indonesia may be shown such as in the following table :

Table 1. Harvested area, production and productivity of Citrus in Indonesia (1970 - 1979).

Year	Harvested Area (Ha.)	Harvested Trees	Production (ton)	Productivity (kg/ ha.)
1970	23,693		107,432	4,538
'71	31,497		139,228	4,420
'72	26,742		147,639	5,521
'73	34,178		170,925	5,001
'74	33,374		210,166	6,297
'75				
'76	35,025	8,859,477	152,702	4,360
'77	30,942	7,543,890	201,175	6,502
'78	31,005	6,985,059	220,930	7,126
'79	26,977	6,366,574	187,967	6,968

Source : Directorate General of Food Crop Agriculture.

The figures of harvested area are respectively 23,693 ha. in 1970 and 26,977 ha. in 1979, and there was no big increase after 9 years. The largest figure was over 35,000 ha. in 1976 and the figure was continuously more than 30,000 from 1973 to 1978. It is not known whether the decrease in 1979 was due to biennial bearing or caused by certain diseases like Virus diseases.

Having shown yearly fluctuation, production quantity increased from about 100,000 tons in the beginning of 1970 to 187,967 tons in 1979 and the rate of increase was 175%. Especially the production reached a peak of about 220,000 tons. Productivity is around 4 - 7 tons per hectare and is very low. This will be explained later in V-4-1.

Next, the regional tendency of harvested area and production in Indonesia is shown in Tables 2-1 and 2-2. The yearly fluctuation is so keen that the average figure of two consecutive years is used. Table 2-1 shows the figures for each region, and Table 2-2 shows the figure of main producing provinces which produce more than 10,000 tons per year.

Table 2-1. Harvested area and production of Citrus in the regions of Indonesia

Region	Harvested Area (Ha.)				Production (ton)			
	'70+71 / 2	'72+73 / 2	'76+77 / 2	'78+79 / 2	'70+71 / 2	'72+73 / 2	'76+77 / 2	'78+79 / 2
Jawa & Madura	17,395	18,141	16,993	12,170	73,651	93,410	80,997	62,199
Sumatera	5,081	5,964	5,543	6,224	27,229	30,435	32,118	40,498
Kalimantan	722	1,430	2,032	2,057	2,008	4,684	4,043	8,600
Sulawesi	1,258	1,472	2,260	1,899	4,120	6,055	7,962	15,157
Maluku & Irian	123	477	1,885	2,008	841	4,233	14,832	19,351
Bali & Nusa Tenggara	3,019	1,369	4,272	4,635	15,483	20,466	36,988	58,667
Indonesia	27,595	30,460	32,984	28,991	123,330	159,282	176,939	204,449

Table 2-2. Harvested area and production of Citrus in Main Producing Provinces

Region	Harvested Area (Ha.)				Production (ton)			
	'70+71 / 2	'72+73 / 2	'76+77 / 2	'78+79 / 2	'70+71 / 2	'72+73 / 2	'76+77 / 2	'78+79 / 2
Bali	1,711	1,762	2,832	3,612	9,620	14,204	25,903	48,571
Central Java	6,071	5,381	5,430	4,354	31,957	27,968	27,633	23,320
East Java	5,894	7,275	6,999	3,825	32,276	46,713	33,260	19,130
West Java	5,000	4,938	4,201	3,715	7,421	16,971	17,683	18,227
Maluku	88	401	1,705	1,529	700	3,859	14,807	16,908
South Sulawesi	820	829	1,166	899	2,970	3,985	5,277	12,956

Source : Directorate General of Food Crop Agriculture.

According to Table 2-1, Java and Madura show the biggest figure and Sumatera holds the third place next to Bali & Nusa Tenggara with the average production of about 40,000 tons in 1978 / '79. The main producing provinces in Sumatera are Aceh, South Sumatera and North Sumatera. In spite of the area and production which are not so big at present in Kalimantan, this region has a rate of increase four times as much exceeding the area and production in 1971. In Kalimantan, South Kalimantan is the main producing province and has a production of over 6,000 tons.

As for Table 2-2, the provinces of Java show a decreasing tendency, but the other provinces show the contrary, probably because new planting was made in the 1970-s in the latter. Regarding the figure of production, Bali province holds the first place with 48,571 tons as the average amount of 1978 / '79 (54,832 tons in 1978 alone), then follows Central Java on the second place with 23,320 tons, third : East Java with 19,130 tons, West Java with 18,227 tons on the fourth, fifth is Maluku with 16,908 tons, and on the sixth place is South Sulawesi with 12,956 tons. The rate of increase in contrast with the average production of 1978 / '79 and that of 1970 / '71 was five times for Bali, 4,4 times for South Sulawesi, while all the provinces in outher islands show figures more than twice as much, but provinces of Java show a falling tendency except for West Java (2.5 times), being 70% for Central Java and 60% for East Java, thus averagedly 84% for the entire Java.

V-1-2 Variety.

Many Citrus varieties are being grown in Indonesia now, but in the statistics only Jeruk Keprok, Jeruk Siam, Jeruk manis and Jeruk Besar are mentioned, and the other Citrus varieties are gathered under the item of " Jeruk lain - lain ".

Jeruk keprok belongs to the family of Mandarin, of loose-skin character and the most common variety in Indonesia. By the survey in the producing area and the market, we found some different varieties among jeruk keprok. In South Sulawesi, two different varieties were found which have different tree performances and fruit shapes, to be explained later in V-3-2. The fruit texture is generally soft and juicy, and fruit quality ranks at the upper grade of middle class with sweetness and acidity. The seed is found in large number.

Jeruk Siam also belongs to the family of Mandarin, and sometimes it is rather difficult to distinguish between Jeruk Keprok and Jeruk Siam. Therefore surveys and classification are desirably to be performed by a specialist of variety.

Jeruk manis belongs to Sweet Orange. This fruit is found somewhere in Java and Bali. Fruit quality is less than average because the fruit size is small, the skin is thick and flavor is little.

Jeruk besar belongs to the Pummelo group. Many trees of this variety are grown in Java and Bali. The fruit of Balinese origin has especially good quality, hence the name Jeruk Bali commonly used to call this varieety. The propagation employing layering method is being performed in Bali, according to some information heard. In South Sulawesi, some trees were found to be planted around scattered spots, with a quality inferior to that of original Bali-grown ones.

The variety called grapefruit in the neighborhood of Jakarta has good taste with thick peel and much juice. This variety is commonly called jeruk Bandung and seems to be different from the ordinary grapefruit.

Among the other Citrus varieties, Jeruk nipis which belongs to the Lime group is planted in many places and is generally utilized as spice.

Table 3 shows the quantity of production, classified by variety in the provinces of Java and Bali in 1980.

Table 3. Production classified by variety in the Provinces of West Java, East Java and Bali (1980)

Region / Variety	West Java	East Java	B a l i	
J. Keprok	10,694	7,746	67,563	Mandarin
J. Siam	89,954	4,101	3,241	Mandarin
J. Manis	-	2,442	-	Sweet Orage
J. Besar	14,459	12,176	3,158	Pummelo
J. lain-lain	10,779	5,524	3,328	Other Citrus
T o t a l	125,890	31,989	77,290	

Source : Food Crop Agricultural Service of each province.

(Note) The above-mentioned figures of West Java are quite different from those shown in Table 2. These are based on the Report of Horticultural Activity in West Java 1980 (West Java Province Crop Agricultural Service) pp. 6-8.

V-1-3 General condition of cultivation.

The condition in South Sulawesi will be referred to later in V-2 and V-3. Three provinces of Java and Bali seem to have advanced technically more than South Sulawesi. And the extension and research agencies look for Citrus more actively. Agricultural Extension Service carries out the distribution of grafted nursery plants, and matters concerning stock are managed by the provincial nursery field and research institution. Plant management is fairly good, viewed from the fact that tree trunks are whitewashed, but training and pruning are still insufficiently done.

There used to be a severe damage by Citrus Vein Phloem Degeneration (CVPD) in Java and now people there are making efforts to control such disease by distributing CVPD-free nursery stock. But near Garut (West Java) there is an area severely infected, and we hope the necessary control measure will be taken as soon as possible for such an area.

In Jeneponto, South Sulawesi, we found some trees showing symptoms resembling those of CVPD; therefore it is quite important to continue the observation and analysis of such symptoms and to contemplate the counter measures in advance.

As for CVPD, please refer to the report by Dr. IEKI, JICA short-term expert on Citrus diseases who stayed in Ujung Pandang from January 20, to March 18, 1982.

Previously CVPD was considered to be a Virus disease. However, owing to recent studies, CVPD has been judged to be caused by a Mycoplasma-like organism and to be the same as greening disease which prevails among South-east Asian Countries.

As for grafting, rough lemon is mainly used as stock. In Bali, the technique of grafting has advanced and the growing of grafted nursery plants looks very well.

V-2 Citrus Production in South Sulawesi and the Position of Kabupaten Jeneponto

As for Citrus production in South Sulawesi, the main variety is Jeruk keprok which is of loose-skin character. Jeruk besar (*Citrus grandis*, *C. maxima*), jeruk purut (*C. histrix*), jeruk nipis (*C. aurantifolia*) and a few oranges are also cultivated. But the variety names are quite uncertain.

The statistics of Citrus production in South Sulawesi and Kabupaten Jeneponto are shown in Table 4-(1-4). The number of planted trees has increased recently and the production quantity is also increasing sharply while showing yearly fluctuation. The position of Citrus among all the fruit production is shown in Table 5. The percentage of Citrus is about 5% in the total fruit production in South Sulawesi and is rather low. But in Kabupaten Jeneponto, the percentage of Citrus is very high, i.e. 81.5% (1979) and 86.1% (1980).

Under the present condition, Citrus price is so high that it contributes to the farmers' income because the supply is quite limited for the large demand. Therefore the new planting of Citrus trees is being progressed remarkably in the entire area of South Sulawesi as shown in Table 4-(3). Since 1976 more than 150,000 trees new plantings have been made each year in South Sulawesi and in 1979 about 370,000 trees were newly planted, therefore a total number of 1,200,000 trees were planted between 1974 and 1980. Five to six years later when these become adult trees, about 3,000 hectares (calculated 400 trees per ha.) will be added to the present orchard and the production will also make a rapid progress.

On the other hand, the position of Kabupaten Jeneponto in South Sulawesi is high in both the harvested tree (43.8%) and production (39.7%) as shown in Table 4-(1) and (2). However, tree planting showed a high percentage of 33-20% in the period of 1975 - 1977 (See table 4-(3)), but the figure has decreased after 1978, namely 3.3% in 1979 and 3.2% in 1980. Consequently the cumulative number of new planted trees in 1974 - 1980 was 1,200,000 for the entire South Sulawesi and only about 100,000 for Kabupaten Jeneponto which is 8.6% of the province. If this tendency should continue for several years, Kabupaten Jeneponto which maintains predominance at present is estimated to descend in its position within a decade. The decrease of new tree planting in 1974 - 1980 may be attributed to the fact that there were many withered trees due to the shallow and sticky soil condition.

But the dry weather at the maturing age can be considered as a merit to grow fruit of good quality and Kabupaten Jeneponto has a good location for the marketing of fruit to the big market at Ujung Pandang; therefore if the farmers will improve their cultivation of Citrus trees, Jeneponto can be a prosperous Citrus producing area in the future.

Table 4-(1-4). Citrus Statistics in South Sulawesi Province and Kabupaten Jeneponto (1974 - 1980)

Year	(1) Harvested trees			(2) Production (ton)		
	South Sul	Jeneponto	%	South Sul	Jeneponto	%
'74	72,794	1,225	1.6	2,685	228	8.5
'75	38,680	2,448	6.3	3.048	80	2.6
'76	166,534	8,600	5.2	4,165	194	4.7
'77	200,686	43,127	21.5	8,311	2,365	28.5
'78	157,071	12,090	7.7	5,072	682	13.4
'79	203,103	33,449	16.5	8,891	1,378	15.5
'80	342,599	149,985	43.8	22,144	8,796	39.7

Year	(3) New planted trees			(4) Productivity (kg/tree)	
	South Sul	Jeneponto	%	South Sulawesi	Jeneponto
'74	74,776	-	0	37	186
'75	38,499	12,712	33.0	79	33
'76	156,650	23,500	15.0	25	23
'77	140,136	29,064	20.7	41	55
'78	220,563	19,500	8.8	32	56
'79	374,123	12,465	3.3	44	41
'80	188,647	5,978	3.2	65	59
	1,193,394	103,219	8.6		

Source : Statistics of Agriculture in South Sulawesi

Table 5. Fruit Production Volume in South Sulawesi and Kabupaten Jeneponto (1979 - 1980)

Ton

Year / Item	South Sulawesi				Jeneponto			
	1977	1978	1979	1980	1977	1978	1979	1980
Citrus	13,480	5,070	8,980	22,140	2,370	680	1,380	8,800
Avocado	50	950	1,210	800	-	-	-	-
D u k u	3,120	17,660	3,110	14,610	-	-	-	-
Durian	2,760	4,090	5,080	5,960	-	-	-	-
Guava	6,380	27,270	214,890	252,360	110	5,200	-	210
Mango	45,210	19,340	25,970	15,490	1,700	3,120	120	860
Banana	88,340	62,670	102,180	82,330	3,670	8,500	180	290
Papaya	17,770	5,930	4,680	8,140	130	40	-	10
Pine-apple	21,310	5,420	3,050	2,440	20	30	-	-
Rambutan	1,380	440	450	680	-	-	-	-
Sallacca	900	1,690	4,150	4,450	-	-	-	-
S a w o	10	20	20	50	-	-	10	40
Total	200,710	150,550	373,770	409,450	8,000	17,570	1,690	10,210
Citrus Weight (%)	6.7	3.4	2.4	5.4	29.6	3.9	81.5	86.1

Source : Statistics of Agriculture in South Sulawesi

V-3 Present Situation of Kabupaten Jeneponto

V-3-1 The trend of Production Quantity and the Area being cultivated.

According to Table 6, figures representing Jeruk Keprok in Jeneponto in 1980 are respectively : 404,734 planted trees; 148,535 harvested trees (37% of the planted ones) and production quantity 8,760 tons. Besides, some figures are mentioned under the items of Jeruk besar, Jeruk manis and other jeruk-s, but their share is very small. For these items, new planted trees were none in 1979 and 1980.

Table 6. Citrus Statistics of Kabupaten Jeneponto - (1)

Item	Year	Planted tree	New planting tree	Harvested tree	Production (ton)	Productivity (kg/tree)
J. Keprok	'80	404,734	19,997	148,535	8,760	58
	'79	392,296	12,465	33,364	1,349	42
J. besar	'80	149	-	121	2.5	21
	'79	469	-	231	3.5	15
J. manis	'80	674	-	597	14.5	24
	'79	714	-	565	6.7	11
Other jeruk-s	'80	1,812	-	1,337	9.4	7
	'79	1,812	-	1,289	19.3	15

Source : Kab. Jeneponto Agricultural Extension Service.

Table 7. summarizes the trend of Citrus production in Kabupaten Jeneponto since 1974, from the Fruit Statistics published by the South Sulawesi Province Food Crop Agricultural Service. In this statistics, all kinds of Citrus are concentrated into one item of " Jeruk " and the total figure of planted trees is unknown. Besides, the figures of 1979 and 1980 are not equal to Table 6. and especially the figures of new planted trees are quite different.

Table 7. Citrus Statistics of Kabupaten Jeneponto - (2)

Year	Newly planted trees	Harvested tree	Production (ton)	Productivity (kg/tree)
'74	-	1,225	228	186
'75	12,712	2,448	80	33
'76	23,500	8,600	194	23
'77	29,064	43,127	2,365	55
'78	19,500	12,090	682	56
'79	12,465	33,449	1,378	41
'80	5,978	149,985	8,796	59

Source : South Sulawesi Province Food Crop Agricultural Service.

In order to see past trend, Table 8. is made by the combination of Table A (p. 70, Final Report on Phase II. Vol II - May 1979) and Table 6. (The method of combination is explained as the footnote of Table 8). By this Table 8, over 50,000 trees have been planted newly each year since 1972 and consequently the planted area increased sharply from ca. 6,000 trees (less than 20 hectares by the calculation of 400 trees per ha.) in 1970 to ca. 163,000 trees (± 400 ha.) in 1975 and then up to about 400,000 trees (± 1,000 ha.) in 1980.

As the newly planted trees may reach the bearing age generally in about 7 years, we consider that 112,570 trees planted in 1974 will be bearing -age trees in 1980. However, harvested trees numbered about 150,000 in 1980, exceeding the number of bearing-age trees (112,570). It is thus understood that there were many trees which bore fruit after 6 years. Owing to the above results, the production in 1980 was 8,796 tons, considerably exceeding the figure for 1979 which was the past highest.

Taking into consideration the above-mentioned data, we estimate that Citrus production in Kabupaten Jeneponto will be sure to exceed 10,000 tons after 2 or 3 years because of the sharply increasing number of bearing-age trees and the appearance of harvested trees which may exceed the number of bearing-age trees on account of the improved farm management and the better climatic conditions.

Moreover, after 5 years, i.e. in 1986, about 404,000 trees planted in 1980 will all be bearing-age trees; therefore it will be certain that the production quantity will be over 20,000 tons provided there will be no severe climatic disaster.

Table 8. Trend of Citrus Production in Kab. Jeneponto

Year	New tree planting	Planted trees	Planted area (ha.) 400 trees/ha	Bearing-age tree (A)	Harvested tree (B)	Harvested tree % (A/B x 100)
1970	4,883	6,645	16.6			
'71	8,084	11,531	28.8			
'72	56,086	19,615	49.0			
'73	36,869	75,701	189.3			
'74	50,604	112,570	281.4	2,333	1,225	52.5
'75	65,407	163,174	408.0	3,499	2,448	70.0
'76	61,129	228,581	571.4	6,648	8,600	129.4
'77	49,740	289,710	724.3	11,531	43,127	374.0
'78	52,819	339,450	848.6	19,615	12,090	61.6
'79	12,465	392,269	980.7	75,701	33,449	44.2
'80	19,997	404,734	1,011.8	112,570	149,985	133.2
'81		424,731		163,174		
'82				228,581		
'83				289,710		
'84				339,450		
'85				392,269		
'86				404,734		

Notes from Table 8 :

1. Figures of new tree planting each year is calculated from the year age on page 70 of the Final Report of Phase II, Vol II. But the figures for 1979 and 1980 are based on Table 6.
2. The figure of planted trees in 1979, and 1980 is based on Table 6.
3. Planted trees in 1978 are calculated by deducting 52,819 trees (planted in 1978) from 392,269 planted in 1979.

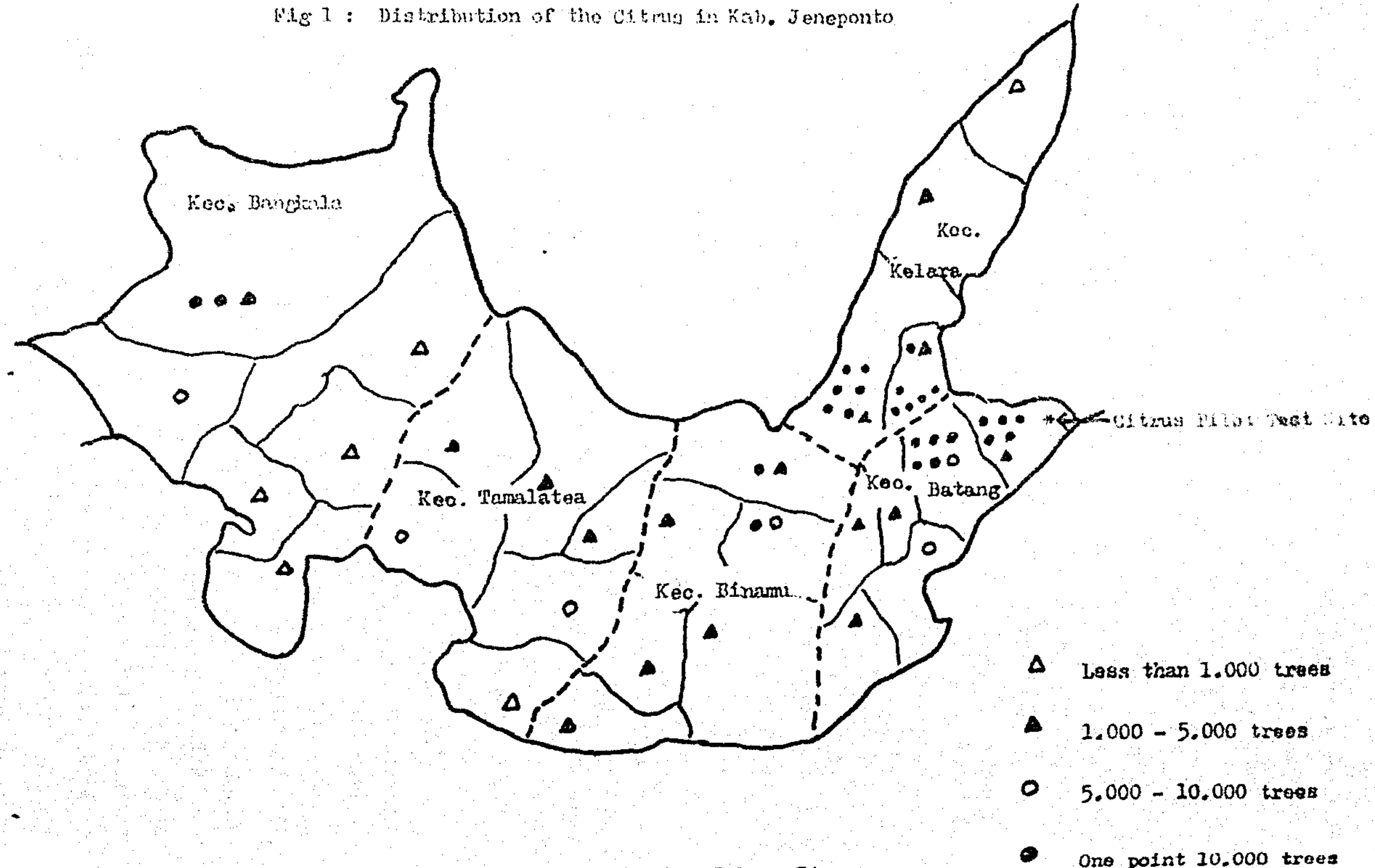
4. Figures of planted trees before 1977 aré calculated the same way as mentioned under note no. 3.

5. Figure of bearing-age trees is the same as that of new planted trees of 6 years before.

6. figures of harvested trees are based on Table 7.

Figure 1 is derived from p. 74 of the Final Report on Phase II, Vol. II, to show the regional distribution of Citrus trees in Kabupaten Jeneponto. As clearly mentioned in the figure, Citrus trees are mainly planted in Desa Tino and Taroang of Kecamatan Batang and Desa Tolo and Gantarang of Kecamatan Kelara. About 60,000 trees are planted in each area. Next to the above two areas, over 10,000 trees are planted in each of the following areas, namely Desa Rumbia of Kecamatan Kelara, Desa Bulujaya of Kecamatan Bangkala and Desa Paitana and Bonto Matene of Kecamatan Binamu. In the Citrus producing areas of Kecamatan Batang and Kecamatan Kelara the soils are volcanic ash soil of Mount Lompobattang and are very viscous. Besides, the soils are shallow and contain much gravels. However, in the areas of Kecamatan Tamalatea and Kecamatan Bangkala, the soils are sandy loam and the soil horizons are deep. So if irrigation will be available in the dry season, some areas will become good producing areas.

Fig 1 : Distribution of the Citrus in Kab. Jeneponto



Source ; FINAL REPORT on PHASE II Page 74.

V-3-2 Variety.

As for the Citrus varieties grown in South Sulawesi Province, 10 varieties are mentioned in " Data and Information of Citrus Cultivation in South Sulawesi " (1978) by Mr. A. Azis Lahiya. However the following four varieties are being grown as main varieties, namely, Jeruk Keprok, Jeruk Besar (Jeruk Bali), jeruk nipis and jeruk purut, the outline of which is explained hereafter.

(1). Jeruk Keprok :

Main variety of Citrus production not only in South Sulawesi but also all over Indonesia. Two different sub-varieties are found in this variety, which clearly differ in tree performance and the fruit shape. Some leaders distinguish these two varieties by the names of Ponkan and Tankan, but these names are not so commonly used. Sometimes varieties are called by the name of their origin; in Jeneponto the former is called jeruk Selayar and the latter jeruk Jeneponto. Besides the above-mentioned two varieties, jeruk keprok has several other varieties. These are Citrus of loose-skin character and the skin is easily peeled off by hand. And they are juicy and have sweetness and acidity, thus having a high commercial value. In this connection we have used the provisional names of Ponkan and Tankan in all the ATA-140 project reports.

1) Ponkan : the tree is upright, the leaf has small wings; the branch is thorny, probably because of the seedling. The fruit weighs about 120 grams; fruit size is large grade of medium size and fruit shape is between oblate and subglobose. Peel is a little thicker than Tankan. The number of seeds is generally large and the seed is poly-embryo. Has a good taste but the segment is a little hard. Maturing is one month earlier than Tankan. The only variety planted in Kabupaten Selayar and in Kecamatan Bonto Tiro of Kabupaten Bulukumba. Introduction was made from Kabupaten Selayar to the other places. It is said that the Dutch people introduced this variety to Selayar in the Dutch colonial period but it is not certain.

2) Tankan : the tree is more spreading than Ponkan, and the small wing in leaves and thorn in branches are similar to those in Ponkan. Fruit shape is close to oblate. Fruit weighs about 140 grams. Peel is very thin and the segment is so full that its tight round shape is visible from outside. There is a large number of seeds and the seed is poly-embryo. The fruit is juicy, has good taste but the segment is as hard as that of Ponkan. Maturing period

is a little later than Ponkan and lasts from May to the end of August. As this variety is sometimes called jeruk Jeneponto, the main part of Citrus orchard in kabupaten Jeneponto and in kabupaten Bantaeng is occupied by this variety. In some parts of kabupaten Jeneponto this variety is called "lemo Cina" but in some cases people call Ponkan and Tankan together as "lemo Cina". The origin of its introduction to South Sulawesi is uncertain and it is said that this variety was introduced by trade ships from South China where its name "lemo Cina" seems to stem. In kabupaten Selayar, Ponkan is the only variety grown and no Tankan is found there. We may thus suppose that there must have been two different routes of Citrus introduction to Selayar and Jeneponto.

(2). Jeruk besar (jeruk Bali) :

Several trees are grown in some farmers' homeyards but it is uncertain if there is an orchard of this variety alone. Tree vigor is very strong; height reaches up to 4 - 5 meters. The leaf is large, thick and large winged. Fruit size is the largest among Citrus varieties and the weight sometimes reaches up to 1.5 - 2 kg. Fruit shape is various, including oblate, globose, ovoid, obovoid etc. Peel is generally thick and especially that of this area is so thick that pericarp ratio becomes about 30%. Pericarp color is white, pink or red. The variety in this area generally has a coarse texture, contains less juice and has some bitterness in taste. A few of them, however, taste good. Harvest seems to start from medio March. In case of a too early harvest, texture may be hard and the taste will not be good. Therefore it is better to postpone harvest for 1 - 2 months and let the fruit ripen fully on the tree.

(3). Jeruk nipis :

This variety belongs to the common name "lime" and is widely used as condiment for cooking and also for medical use. The tree is spreading; branches are thin and grow densely. The leaf is somewhat oval and small-winged. Fruit shape is globose, oblong and sometimes fusiform. The fruit is light-weighted. Just about 40 - 60 grams. Pericarp is soft, juicy and has a special flavor. Fruit juice has quite a high acidity, i.e. around 6%. In this area, jeruk nipis is sold commercially all year round owing to its ever-flowering nature and the different in flowering/maturing period due to the difference in height and the time of rainy/dry seasons. In the dry season the fruit has less juice.

(4). Jeruk purut :

This variety is called Tanning generally in this area. Tree vigor is strong. The tree grows tall and spreading, the mature tree shows a semi-circular type. Thorns are thick and sharp, reaching a length of 5 - 8 cm. and are numerous. Leaf is large winged. The fruit is of medium size. The peel is very coarse, resembling that of rough lemon; thickness around 4 mm. Peel contains turpentine oil with unsweet smell. Peeling is hard. Sugar content (brix) of the fruit juice is around 10. Jeruk purut is widely used as fresh fruit, spice and medicine. Maturing period occurs around June - July.

V-3-3 Present Situation of Cultivation.

According to the structure of tree age mentioned in Table 8, trees over 10 years old planted before 1970 occupy a little under 2% while those under 6 years planted after 1975 are about 60%. Under this circumstance, as we mentioned before, it is certain that the production will expand rapidly in the future. However, we cannot help saying that the present situation of cultivation is rather extensive, and the citrus trees have just been planted and scarcely taken care of, not only in Kabupaten Jeneponto but also everywhere else in South Sulawesi. We only see the application of compost and inorganic fertilizers once a year and spraying for insect/disease control 1-2 times a year in some citrus orchards of large-scale owners. In other words, no practice of cultivation has been carried out in the majority of Citrus orchards in this region.

(1). Planting

As for the planting method, seedlings are planted in the tree holes of a size just enough to receive the seedling. No treatment is given to seedlings and no protection is prepared for the drying of roots during the planting work. Consequently the nursery plants have a very low survival rate and they grow in a poor way of growth. Citrus trees being perennial crops, elaborate care should be given for the planting of nursery plants. As for the planting space, 5 m x 6 m, 6 m x 6 m and the combination of these spaces are being practised with row trans-planting or regular triangular planting. Under present condition, seedlings are commonly used as nursery plants and no damage has been caused by dense planting (In some places where trees are planted at narrower spaces than the above-mentioned, some damages caused by dense planting are seen). In the future when grafted nursery plants will be used, the planting space will have to be studied again in relation to the kind of stock.

After planting, no training and no pruning have been done thus far. Several thin and weak scaffold limbs grow from the root and they grow very tall. As the seedling is used, trees have so many thorns that it becomes dangerous for the practice of cultivation such as pruning, harvesting etc. If the grafted nursery plants are to be used for Ponkan and Tankan, there will be little growth of thorn.

(2). Intercropping.

Moreover, in citrus orchards in South Sulawesi Province, intercropping of maize, leguminous crops, cassava etc. are commonly practised even near the root of trees in the rainy season. In our opinion this intercropping does harm to the growth of Citrus trees. In case the intercropping continues until August or September in the dry season, the harm will be serious on account of water physiology, amount of sunshine and manuring practice.

(3). Thinning

Fruit thinning has never been practised either. Due to the above-mentioned condition, in the bearing year the trees bear too many fruit leading to self withering caused by competition of water consumption. And this occurrence of withered trees has been considerably hindering the productivity.

(4). Insect and Disease Control

Insect /disease control has been carried out to a limited extent in this citrus orchard. Hence many insects like scales, Citrus leaf miners, aphids etc. and many diseases like sooty mold, scab etc. have caused damages in the growth period of Citrus trees which is the rainy season. We have found many symptoms of chlorosis caused by scales in leaves. But we have faund few fruit damaged by insect / diseases, probably owing to strong rains and natural enemies. Among diseases, the most fatal one is foot rot (Phythophtora spp.) which has already appeared in the southern part of the province, namely the kabupaten-s of Jeneponto, Bantaeng, Bulukumba, and Selayar, and has become the big reason for withered trees. It is not clear yet as to the countermeasures herefor, but we can prevent foot rot to some extent by the quick discovery of the symptoms, the treatment of affected part and the drainage equipment to prevent excess of moisture in soil during the rainy season. As for foot rot, please refer to the report made by Dr. H. IEKI who investigated the Citrus diseases as a JICA short-term expert during the term January to March 1982.

(5). Harvesting

The harvest period differs with the varieties and environmental factors. Ponkan and Tankan in kabupaten Jeneponto are mainly harvested around May and August. At this moment, harvest is conducted manually and no scissors are used. Regarding harvest quantity, in many places it has been found to amount to 2,000 - 3,000 fruit per tree, which is deemed as overbearing. But according to the statistics, yield per tree is about 50 kilograms (600 fruit) and this figure is the average of harvested trees only. Many trees without bearing being found in the orchard, the yield per unit area is very poor i.e. 20 tons per hectare.

V-4 Points At Issue and Measures To Be Taken

V-4-1 Productivity.

Productivity is mentioned as the yield per harvested tree in the statistics made by the Food Crop Agricultural Service of South Sulawesi Province and such productivity sometimes exceeds 100 kg tree in several kabupaten-s. The average productivity between 1974 and 1975 in the entire Sulawesi was 46 kgs (Table 4-(4)). This figure indicates not a small yield for South Sulawesi where the majority of citrus trees are under 10 years of age. However, this figure shows the average yield per harvested tree and many trees of the same age which had no harvest were seen in the same orchard at the time of survey. Therefore, it is quite risky to make a comment on the productivity with the yield per harvested tree and it will be necessary to examine the productivity per unit area.

According to the statistics of Directorate General of Food Crop, Ministry of Agriculture (Table 1), productivity per ha. in all Indonesia was 4 - 7 tons and that of South Sulawesi was 6.7 tons by the average of nine years from 1970 to 1979 (1975's is missing) which is higher than the average of all Indonesia, but it is considered to be very low as compared with the level of citrus production of the main producing countries. In this connetion, the yield per ha. of the main citrus producing countries is shown as follows :

Country	Variety	Yield per ha.
U. S. A.	Valencia orange	36 tons
Japan	Satsuma mandarin	25 - 30 tons
Spain	Mandarin	30 tons

And some examples in kabupaten Jeneponto are shown as follows :

(Farm A) ;

600 trees, 8 years old, are grown in 2.5 ha. (240 trees/ha.) and the sales amount in 1980 was said to be Rp 1,850,000. Supposing that the unit price of a Citrus fruit is Rp 20 and the average weight of a Citrus fruit is 100 grams, we can calculate 9,250 kgs. as the total quantity and 3.7 ton per ha. In this orchard there are 12 withered trees found after harvest.

(Farm B) ;

700 trees, 15 - 20 years old, and 800 trees, 10 years old, thus 1,500 in total, are grown in 6 ha. (250 trees/ha.) and the sales amount

in 1980 was said to be Rp 12,500,000 by 400,000 fruits. Supposing the average weight to be 100 grams., we can calculate 40,000 kg. as the total quantity and 6.7 ton per ha. In this orchard many trees bear 2,000 - 3,000 fruit per tree, but some of them withered after harvest. The owner estimated the production in 1981 as 10,000 fruits and the quantity was actually very small.

(Farm C) ;

60 trees, 17 years old, are grown in 0.25 ha. (240 trees per ha.) and the sales amount in 1980 was said to be Rp 1,000,000. By the same calculation as before, we estimate the total production at 5,000 kgs. and the yield per ha. at 20 tons.

(Farm D) ;

200 trees, 20 year old, and 800 of 10-years old trees, thus,1,000 in total, are grown in 5 ha. (200 trees/ha.), and the sales amount in 1980 was said to be Rp 7,000,000. By the same calculation we estimate the total production at 35,000 kgs. and the yield per ha. at 7 tons. The production quantity in 1981 was very small in this orchard, too.

As mentioned above, the productivity per unit area in a year is very low and the average productivity in two consecutive years is lower because of the strong tendency of biennial bearing. Regarding the technical reasons for such a low productivity, explanation will be given in V-4-2 onward and main points at issue are summarized as follows :

(1). It is necessary to manage the orchard with the idea of "Cultivating Citrus". As mentioned previously in V-3, the farmers simply planted Citrus trees and have scarcely conducted management practices. In the present situation, improvement of productivity can hardly expected.

(2). Tree population in a unit area is generally few and withered trees are neglected. The tree population per ha. was 200 - 250 trees in the above -mentioned examples and was 236 or 278 trees according to the statistics of the Food Crop Agricultural Service. On the other hand, planting space is mainly 5 m x 6 m (333 trees ha.) or 6 m x 6 m (278 trees ha.) according to our survey, which seems proper for the seedling of Jeruk keprok, the mainly variety in this area. A wider planting space may be necessary for Jeruk Besar and Jeruk Purut. Withered mature trees are often seen left in the orchard, which should be replaced by supplementary planting because these withered trees seriously reduce the productivity per unit area.

(3). Improvement of biennial bearing. Although the details will be described in the next section, it is most important in the cultivation to change into the annual bearing type in order to increase productivity and to secure income, because the present situation in this area shows the complete biennial bearing type.

V-4-2 Measures for Production.

As we mentioned the present situation of Citrus production in South Sulawesi including kabupaten Jeneponto, there are many points at issue and items to be improved. Therefore, we will focus the discussion on the important problems in management and some items to be improved immediately.

(1). Nursery stock.

Farmers at present are mostly planting seedlings, but seedlings are unsuitable for the constant fruit production as they grow vigorously but not uniformly. Moreover, as the seedling has sharp thorns, it is inconvenient and rather dangerous for the cultivation and harvest. Under this circumstance it is necessary to spread the technique of grafting and to grow the grafted nursery plant which has excellent characters. (Grafted nursery plants are already well spread in East Java and Bali). In order to grow the grafted nursery plant, first of all the selection of elite mother trees should be sped up and a system for its selection should be established. The Citrus contest is one of such means. However, if we spread the technique of grafting and introduce scions indiscriminately from other areas or islands, there will be fear of virus problem. Therefore, the introduction of scions should be observed fully. As for rootstock, farmers mostly use Tanning (Jeruk purut) now. In order to get a healthy and vigorous nursery plant, the variety of rootstock should also be investigated and studied.

(2). Intercropping.

As mentioned before, intercropping seems to be a cause of hindrance for productivity. Maize and cassava have perticularly a strong fertilizer absorbing power and exert a harmful influence upon the main crop, i.e. the Citrus trees. In this connection, intercropping should be complately abolished in the future in order to perform a sound Citrus production. However, some intercropping at the age of young trees will be necessary from the standpoint of land utilization. Even in such a case, intercropping should be one meter minimum apart from the Citrus tree. And after the start of bearing, maize intercropping should be stopped and leguminous crops will be planted.

(3). Cultivation of green manure.

When intercropping is completely abolished, green manure of leguminous crop should be planted to protect soil run-off in the rainy season. In the dry season, stalks and leaves of green manure are used for mulching to protect the transpiration of soil moisture.

(4). Training and Pruning.

Training and pruning are scarcely carried out after the planting of Citrus trees in this area and there are many main stems which are often extending high and very slender. We do not enter into the technical details here, but we would like to emphasize the importance of training and pruning in order to grow sound Citrus trees.

(5). Fruit thinning.

At the present time Citrus trees are overburdened with fruit in the bearing year and the following year few fruit is seen in the tree. Such a phenomenon may be considered to be due to the following causes: the Citrus has a tendency to blossom and bear fruit beyond its capacity. As little fertilizer is given, the nutrient of the tree is completely consumed in the bearing year. Without training and pruning, the tree body has grown very weak. In this circumstance, in order to adjust the biennial bearing, it is necessary to control fruit by thinning for the time being.

(6). Soil management and Fertilizer Application.

The soil in kabupaten Jeneponto and the neighboring areas is mostly viscous and rather inferior. Besides, the decomposition of organic matter is rapid under the weather condition of high temperature. Therefore, soil improvement is a very important practice. It should be kept in mind that the basis of crop cultivation is to prepare soil and efforts should be made for soil improvement by means of the practices of plowing, mulching, green manure etc. Although Citrus trees require nutrients in rich amount for their own growth and fruit bearing, fertilizer application is now confined to some special farmers and even such farmers apply it once a year only. It is difficult to fix the detail of application (element of fertilizer, volume, time, frequency etc.) at this moment. But if fertilizer application is to be implemented, productivity will certainly be achieved with better nutrition and more vigorous body of the trees.

V-4-3 Form of Management.

We have not enough meterial on this subject, and the following description is mainly based on our survey, The form of Citrus orchard management in kabupaten Jeneponto is deemed to be roughly classified into the following three groups :

(1). Large-scale orchard managed by employed farmers with non-resident landowner;

(2). Medium-scale orchard managed by landowner;

(3). Small-scale planting around farmers' house (several or ten-odd trees) by landowner or tenant farmer

Aiming at the expansion of Citrus industry in kabupaten Jeneponto and expecting and increase of farmers' income, groups (2) and (3) should be fostered and strengthened. As group (2) may become the nucleus of local industry, it would be better to be developed as leader of cooperation for the improvement of technology, production, marketing etc. The share of group (3) is not so big in area and in production quantity, but the number of farmers in this group seems to be the largest. In this relation, the increase in this group's income should be the target of regional development planning. However group (3) is financially very poor as individual and it seems to be difficult for them to carry out new planting, and to provide facilities for production improvement and marketing. So it is necessary to guide them for a cooperative use of such facilities and to support them financially by loan or subsidy. At the same time, in order to win a success of such cooperative use, the understanding and cooperation of group (1) is necessary and the leadership of group (2) has good influence on it. As for group (1), they had better pay more attention to the contract terms with their managers. This group (1) has sufficient funds and is carrying out fertilizer application, but the harvest of intercrops usually becomes an income for manager by the contract. The contract terms might have originated from the idea to compensate for the management cost. However, managers have actually expanded intercropping as much as possible to increase their own income. As referred to previously, the inter - cropping hinders productivity. Therefore, it is recommendable to adjust the contract terms at least to stop intercropping after the start of bearing age.

V-4-4 M a r k e t i n g.

There are various steps in the process of marketing, from the harvest of crops to the market for consumers, but we discuss here mainly the collection of fruits, shipment and transportation.

The important problem is the "ijon" system by middlemen. Although we could not estimate exactly the share of this "ijon" system, we often see middlemen working for harvest, collection and shipment in many orchards and we deem that a considerable amount of harvest is being shipped by this system.

(1). This "ijon" system has the following faults for producers: the contract is made by the tree unit or field when the fruit is still young and green, and the size and quality of ripe fruit have nothing to do with the contract price; consequently producers have no intention to improve quality.

(2). The contract price is always favorable to the middleman.

(3). The middleman wants to harvest when the market price is high and he pays less attention to gain harvest at the proper time. In case the harvest is delayed, the fruit will be too ripe to be of good quality, and the trees will also be badly affected.

However, it is difficult to alter this system immediately and it may be reasonable for governmental agencies to gradually guide the collection and shipment to the direction favorable for producers while supporting the cooperative system of collection and shipment by farmers.

As for the container for transportation, wooden boxes and bamboo baskets are commonly used now and their volumes are around 50 kgs., and sometimes even as large as 100 kgs. The big volumed containers and the bad road condition cause damage to the Citrus on the way of transportation. Therefore, the size of container should be changed to smaller one around 15 - 20 kg. in the future. These containers are at present supplied by middlemen and the risk of damage during transportation is also borne by middlemen. But it has to be considered that all such loss borne by middlemen is reflected in the cheaper price. Moreover, the quality problem during transportation is also serious for consumers. As we have checked only one aspect of the marketing system, we find many problems to be solved and we consider the solution as not so easy. Especially, in order to support the cooperative system, quite big investment will be needed for the collecting yard, warehouse, selecting machine, containers packing machine, weighing apparatus, vehicles for transportation etc.

Equipped with those modern facilities, the price mechanism should be transformed into a modern one. As a conclusion, to improve the marketing of Citrus products, we recommend the Central and local authorities concerned that first of all they will fully understand the present situation by survey and will establish a basic policy of marketing, covering whole channels from farmer to consumer to achieve a gradual improvement.

V-4-5 Preparation of Statistics.

Among the statistical data of Citrus trees we have calculated, we found the figures of harvest area (trees) and new planting area (trees), but could not find the accumulative figure of planted area (trees) except for the the statistics of Kabupaten. Due to biennial bearing, the figure of harvested area for all fruits fluctuates sharply year by year. As mentioned in the section of "productivity" (V-4-1), if we calculated productivity by this figure of harvested area, the result shows a productivy higher than the actual fact and may cause misunderstanding. As for fruit crops which are of perennial character, it is important to know the total cultivated area (in other words, accumulative figures of planted area) in order to understand the present situation and to take measures for development. Therefore we hope that the figure of the total cultivated area will be referred to in the statistics issued by the central and local administrations soon. Additionally, for fruit trees, it is necessary to check the actual condition of withered trees as a negative factor together with the new planting area every year because many Citrus trees wither in a certain year. The annual figure of total cultivated area will be calculated by adding new planted trees and deducting withered ones. Productivity should be based on the actual condition of the orchard; therefore, not only the harvested trees will be included but also all the trees which enter the bearing age, the figure of which be decided for each fruit tree by the authorities concerned. If the accurate productivity can be known, it may be quite useful for the improvement of technology and to take measures for future development.

V-5 Technical Report

V-5-1 Ecology of Citrus trees, particularly tropical ones.

In the temperate zone like Japan, the temperature is the main factor controling the growth of Citrus trees, since germination, elongation, leafing, root elongation, blooming and fruit growth are followed by a rise of temperature, and by a drop of temperature in autumn where ripening, coloring, harvesting, dormancy and flower-bud differentiation occur. However, in the tropical zone like South Sulawesi, it is the water namely the dry/rainy season, that seems to be the main factor equivalent to temperature in the temperate zone.

(1). Germination, blooming and water :

In the model orchard in 1980, two Tankan trees started germination two weaks after the watering on October 8, but in the same orchard and at the same time the unwatered trees started germination after the start of the rainy season at the end of November and in December (Refer to the Fifth and Sixth Quarterly Report of 1980). Moreover, germination started after the first rain in the middle of November by the result of survey in another area, Particularly in the part of Desa Tolo and kabupaten Bantaeng we saw the example that germination and blooming occurred after the first rain, but new leaves were wilted and then flower abscission followed because of no rain afterwards, and the second germination occurred after the rain in December. As mentioned above, there is a close relation between germination, blooming and water (rain); therefore it is quite natural that farmers await the first rain eagerly at the end of the dry season. Besides there was some rain in the dry season of 1981, especially the considerable amount of rain in November, so germination and elongation were quite earlier than in previous year, and blooming occurred at the end of November and the start of December. In Kampung Tombolo, Desa Gantarang of Kecamatan Kelara some examples were seen of the water influence on germination and blooming. In one orchard, germination and blooming started in October, and harvest was possible in April and May as water always runs in the channel along the orchard (Results were similar in 1980 and 1981).

(2). Frequency of germination :

In Citrus trees in the temperate zone, germination and elongation of current shoots are clearly distinguished three times a year, but those are hard to distinguish in the tropics.

According to observation of Tannin seedlings, germination and elongation are repeated from December to August, the midst of the dry season. Even mature trees repeat germination and elongation irregularly as new current shoots start germination and elongation after the greening (about 30 days) of the previous current shoot, Especially in 1982 when much rain poured in the dry season, germination and elongation were performed all year round. Moreover, in the mature orchard , germination and elongation are repeated quite irregularly among trees.

(3). Root elongation :

Root elongation in the tropical zone should differ from that in the temperate zone, but the difference has not been ascertained yet. In this connetion we recommend to start investigation of root elongation using root box without delay because the time and degree of root elongation are the important factors to know the proper time of fertilizer application, pruning, soil management and grafting.

(4). Bearing habit :

Generally, blooming and fruit-bearing occur at the weak mother branch of the bearing shoot with leafless inflorescence or leafy inflorescence of several short leaves. The percentage of leafless inflorescence is large and the flower is small and weak. These tendencies may be considered as the property of the variety, and it is expected that these tendencies will be invesgated soon together with the aspect of physiological fruit drop.

(5). Fruit thickening and ripening :

Figure 2 shows the thickening curve of Tankan fruit done in 1980 from December, just after the blooming, until the middle of April, no observation could be conducted, but according to the condition afterwards as mentioned in Table 2, the fruit diameter continued thickening until early July, and growth rate slackned afterwards, on the other hand, the growth of fruit height slowed down after mid-May. As for fruit weight, the rate of increase was rather high in the two month period from the end of May to the end of July and showed a slow-down tendency in August. The ripening condition of fruit is shown Figure 3. Sugar content increases sharply in the one month period from medio July to mid-August. Acidity shows a declining curve from mid-April when the survey was started, becomes around 1.0% in mid-July, and afterwards continues to decline with a gentle curve and keeps the level of

Fig. 2; Tickening Curve of Tankan Fruit At Desa Tino in Kab. Jeneponto, 1980.

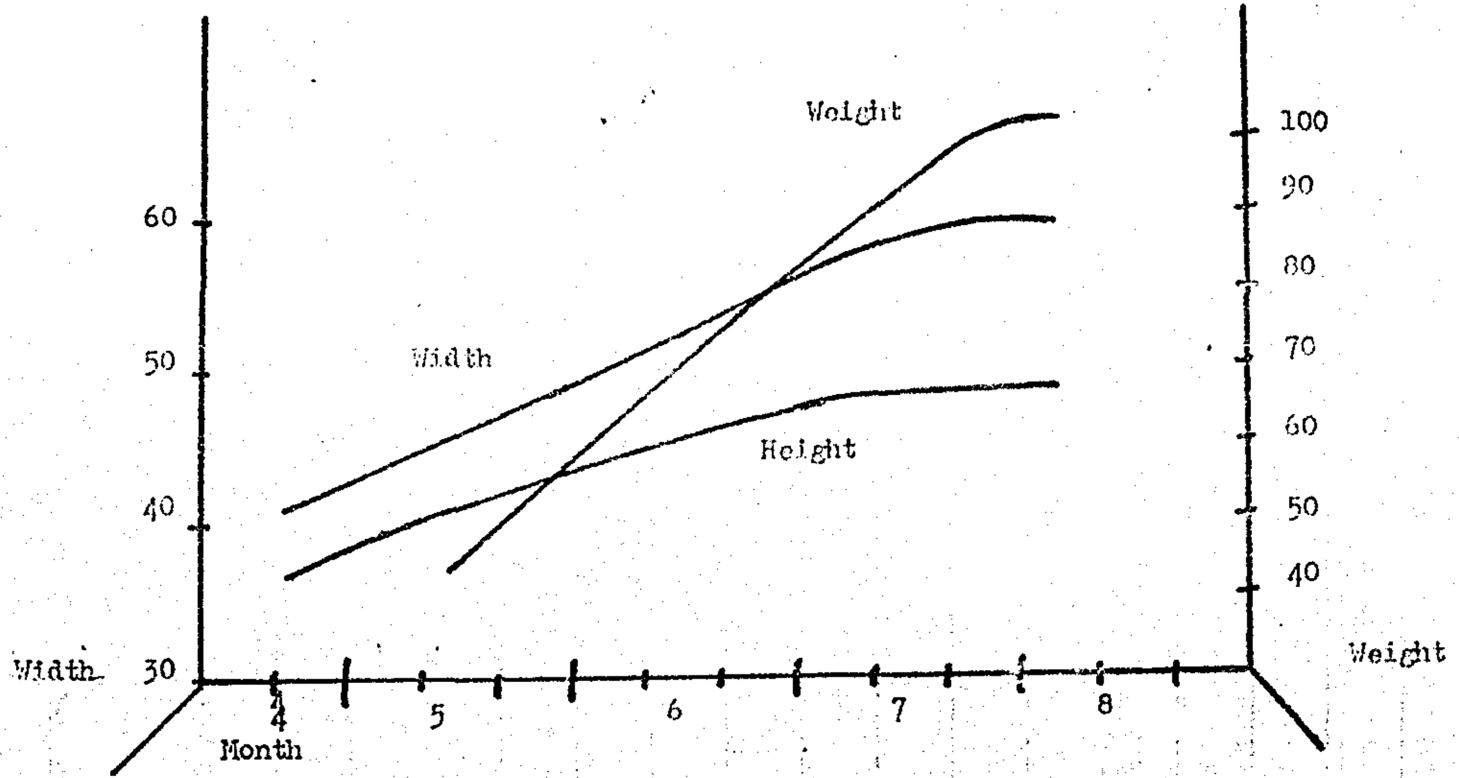
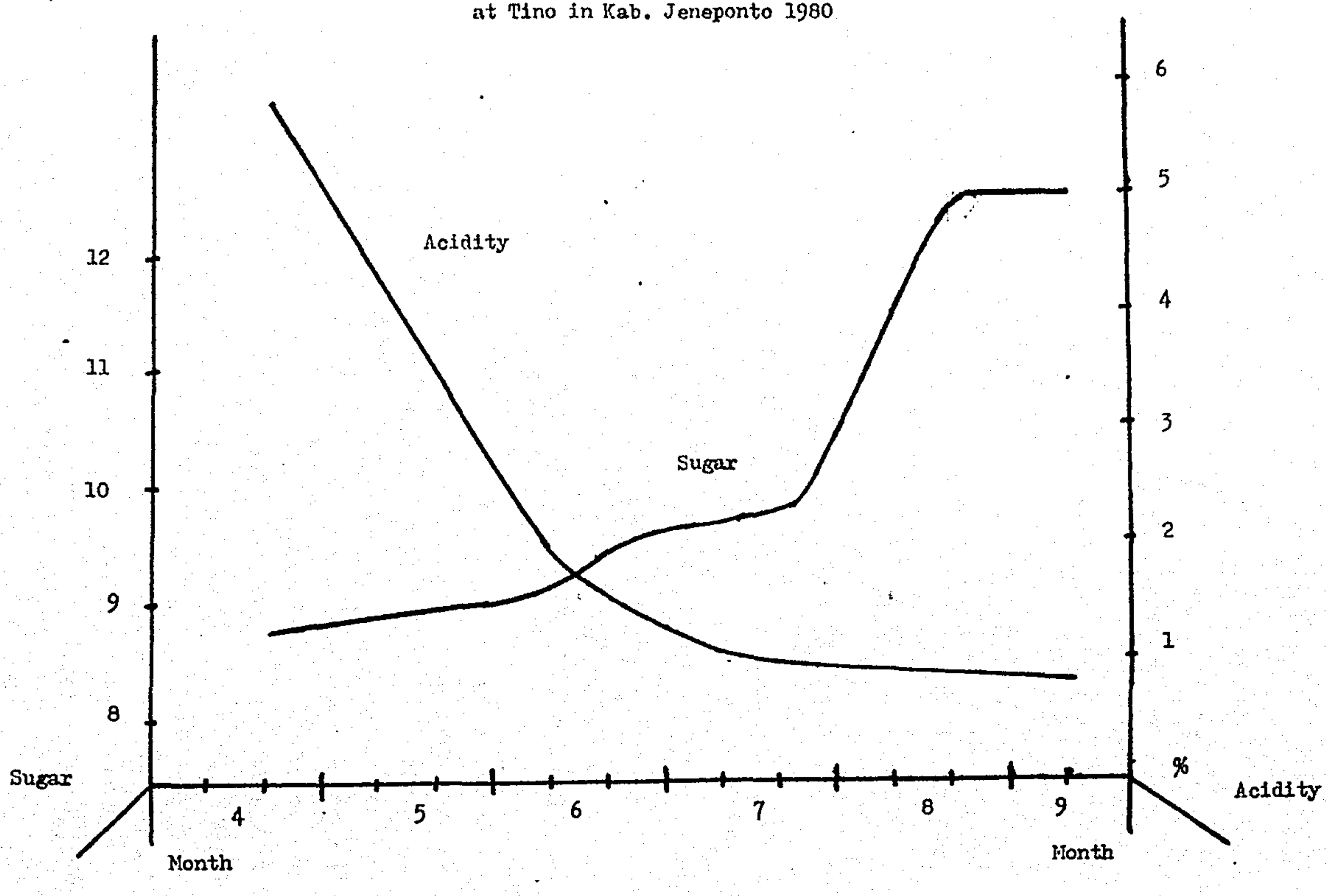


Fig. 3; Ripening Curve of Tankan fruit
at Tino in Kab. Jeneponto 1980



0.8% by medio September, which seems to have a good effect on the taste. As mentioned above, the fact that sugar content increases sharply and the declining speed of acidity slackens after medio July may be attributable to the conscentration of fruit juice due to the drought of dry season starting in such a period. Table 9. shows the result of the survey of fruit thickening done in 1980 and 1981. In 1981, blooming period was delayed for about 15 - 30 days as compared with that in 1980, but the thickening condition in April became nearly similar to the previous year. After that the growth of width was nearly the same as that in previous year until July 22, but the height grew at a higher speed than the previous year. The height stopped to grow afterwards and the width showed an increase only on the last day of the survey, August 22. The fruit grew thus bigger than in 1980 as a whole.

Table 9. Result of the Survey of Fruit thickening (Tankan) in 1980 and 1981

(unit millimeter)

Year / Item / Date	1980 Width	1980 Height	1981 Width	1981 Height	1981 Date
April 23	41.2	37.4	41.0	40.1	23
M a y 13	44.9	40.3	44.2	42.1	7
M a y 27	48.1	42.8	48.0	45.7	20
June 10	51.3	44.9	51.1	50.0	4
June 25	54.9	45.0	55.0	52.4	19
July 10	57.6	48.1			
July 22	59.7	48.2	60.9	57.2	23
Aug. 2	58.9	48.0			
Aug. 22			65.5	56.0	22

Note : 1. Due to theft of fruits, the results on Aug. 2, 1980 and on Aug. 22 1981 were somewhat different from previous ones. After that date, further thefts occurred and the survey was forced to stop in each of the years.

2. The fruits were purchased from the owner as fruit on the tree.

Result of the Citrus Contest held in 1981 showed the tendency of bigger fruit than those in 1980, but the sugar content was lower. The reasons for this is assumed as follows :

In 1981, fruit-bearing quantity was rather small and the growth at the first stage was rapid, especially the growth of height. On the other hand, the large volume of rain in July influenced the growth of width afterwards and the lower sugar content. In both years, height grew fast during the small fruit period and slowly afterwards, while width continued thickening. This curve of fruit thickening is common to all Citrus varieties. The above-mentioned result was obtained from the survey conducted in the existing orchard of Mr. Amiruddin Madjid (Desa Tino) where fruit of one Tankan tree was purchased, and marked 50 pieces each year in 1980 and 1981.

Table 10 and Figure 4. show the result of survey conducted in the model orchard, using two mature Tannin trees from the blooming time until July 2, 1981. Blooming started at the end of December 1980 and continued until around January 10. Blooming period lasted about one month. Greening of current shoot ended by early January. Physiological fruit drop was active from the middle until the end of January, nearly completed at the end of January. Fruit shape is about globose from the fall of the petal until the middle of January. After that, the growth of width gradually surpassed that of height. Until the end of March both width and height had a high growth rate. The rate became lower later, especially that of the height. Consequently, on the last day of the survey, the fruit shape became almost subglobose with the fruit shape index 112.

Table 10. Result of Survey of Tannin Fruit Thickening, conducted in 1981

(unit millimeter)

Date	Width mm	Height mm	Remark on the growth condition
Dec. 18			Blooming started
Dec. 27	3.8	-	Dec. 22 - 27 Full bloom stage; start of flowers and fruit drop
Jan. 10	9.9		Finish of blooming; greening of current shoot
Jan. 22	18.8	-	Peak of the physiological fruit drop
Jan. 29	22.8	-	Finish of the physiological fruit drop
Feb. 19	29.1	27.9	
Mar. 12	37.5	35.4	
Mar. 31	43.0	39.6	
Apr. 16	45.6	41.5	
Apr. 22	44.9	41.2	

Date	Width	Height	Weight	Sugar	Acid
	mm	mm	gm		
May 6	46.5	42.0	52.6	9.7	2.0
May 20	50.2	45.5			
June 3	51.1	46.1	71.0	10.1	1.4
July 2	55.6	49.7			

Remarks of Table 10:

1. The figures were the average of two Tannin trees
2. For four times from Dec. 27 to Jan. 29, 10 to 20 young fruit were picked and only the width was measured. Fruit shape was about globose at that time
3. After Feb. 19, 25 fruit of each tree, totalling 50 fruit, were picked at random; width and height were measured on the tree
4. On May 6 and June 3, 5 fruit were picked at random; weight, sugar and acidity were measured
5. From July 2 on, the survey was forced to stop because of theft of the fruit

(Note : physiological fruit drop)

In many places it was said that many fruit dropped in the period when they were small. This phenomenon is the physiological fruit drop. Citrus trees cause many flower buds, flowers and young fruit to drop; this drop is, in turn, caused by natural selection to remove an excess over the tree capacity and the physiological drop does not lead to a big decrease in production. An example of physiological drop in Japan is shown in Table 11. The number of harvested fruit is usually about 1 - 12% of the total flowers produced.

Table 11. Phase of Physiological Fruit Drop
(Relation of the total number of flowers to harvested fruit)

	Satsuma mandarin		Navel orange		Valencia orange	
	Number	%	Number	%	Number	%
Total drop	9,772	82	4,772	97	7,705	99
Flower bud	3,391	29	2,184	45	3,446	44
Flowers	1,224	10	1,339	28	2,024	26
Young fruit	5,100	43	1,181	24	2,029	26
Fruit	37	0	18	0	206	3

	Satsuma mandarin		Navel orange		Valancia orange	
	Number	%	Number	%	Number	%
Harvested fruit	2,104	12	123	3	119	1
Total number (flowers & fruit)	11,876	100	4,845	100	7,824	100

Results of the survey of physiological fruit drop using several branches of Tannin trees at the same time of the survey mentioned in Table 10. is shown in Table 12. As for fruit of leafless inflorescence, the fruit number on Dec. 27 was 32 and became 4 on January 30, and the fruit of leafy inflorescence decreased in number from 13 to 1 in the same period. The rate of fruit drop was 87.5% for the former and 92% for the later; averaging thus 88.9% (harvested fruit = 11.1%)

Table 12. Physiological fruit drop of the Tannin tree

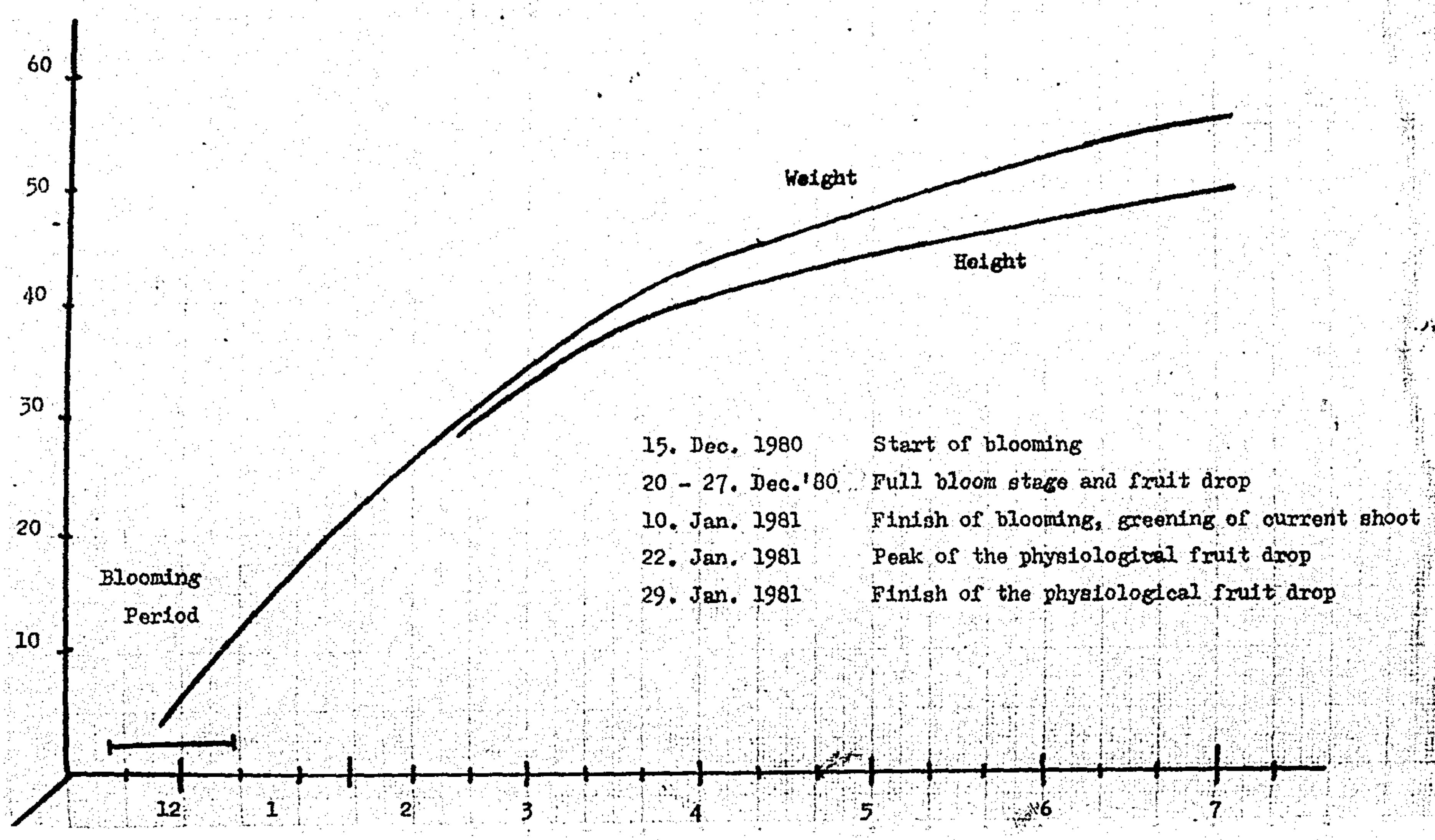
Fruit	Leafless infloresc.				Leafy inflorescence				T o t a l			
	Number		d r o p		Number		D r o p		Number		d r o p	
Date	27/12	30/1	Number	%	27/12	30/1	Number	%	27/12	30/1	Number	%
	7	1	6		4	1	3		11	2	9	
	6	1	5		1	0	1		7	1	6	
	8	0	8		3	0	3		11	0	11	
	5	1	4		2	0	2		7	1	6	
	6	1	5		3	0	3		9	1	8	
Total	32	4	28	87.5	13	1	12	92.0	45	5	40	88.9

(6). Ecology of Citrus tree in the dry season :

Strong winds blow in the height of the dry season from the latter half of July until September in Desa Tino. Consequently wilting leaves appeared obviously since the end of July in 1980. The strong wind affected the physical function as well and many leaves dropped off. This tendency is seen more in trees of excessive fruit-bearing and clearly in the tree of late harvest. Many trees withered afterwards.

At the end of the dry season in 1980, Citrus trees looked like deciduous fruit trees with few leaves. The condition in December 1979 was almost the same as above. At the end of the dry season of 1981, however, some wilted leaves were found, but leaf drop off was little and the trees kept the appearance of Citrus tree. This might be due to the rain during the dry season and to the relatively smaller quantity of fruit-bearing. Citrus trees in this region may be in the flower-bud differentiation physiologically in the latter half of the dry season; therefore it is quite important to have sufficient capacity to assimilate nutrients with sufficient leaves in such period. In this connection it is essential to prevent transpiration from the ground and leaves by mulching, wind control and other necessary measures.

Fig. 4; Thickening Curve of Tannin Fruit at the Model Orchard in Tino, Kab. Jeneponto (1981)



V-5-2 Summary of the survey of Citrus Fruit.

Here we mention the summary of the Survey of Citrus Fruit, studied in various places of the South Sulawesi Province and the markets of Ujung-Pandang, Jakarta etc. The properties of what we call Tankan and Ponkan in South Sulawesi being quite similar to those of what is called Jeruk keprok and Jeruk Siam in other provinces, it was rather difficult to distinguish the one from the other. Outlines of these varieties are as follows:

(1). What we call Tankan:

7 items, 169 fruits were surveyed in 1980 and 16 items, 288 fruits in 1981, both including the Citrus contest. By the result of survey, fruit weight was 100 - 120 grams and there were bigger fruits of 140 to 160 grams in 1981. The majority of shape index was 120 - 130 of oblate and some fruits were around 115 of subglobose. As for the shape around the pedicel, there were various types like high collared, low collared and almost flat type. Peel was very thin. Pericarp ratio was about 85%. The fruit contained much juice and ratio of juice (juice weight/pericarp weight) was about 63%. Sugar content of the mature fruit (sample used for the survey) was around 10 (brix). Acidity was around 1.0. Regarding both the items of sugar and acidity, there was little difference among the fruits of different ripening periods.

(2). What we call Ponkan:

10 items, 81 fruits were surveyed in 1980 and 9 items, 130 fruits in 1981. Fruit weight was mostly 120 - 130 grams. Some fruits in 1981 reached 160 - 170 grams. The fruit in general tends to be bigger than Tankan. Shape index was around 110 and was subglobose. The shape around the pedicel was mostly low collared. The peel was somewhat thicker than Tankan and pericarp ratio was 75 - 80%. Fruit contained much juice like Tankan and ratio of juice was around 66%. As the peel was thicker than Tankan's. The percentage of juice againts the total fruit weight was less than Tankan. Sugar content was about 9 (brix) and acidity was mostly 0.7 - 0.9%.Alike Tankan, there was little difference among fruits of different ripening periods.

(3). Jeruk Keprok in other provinces (Mandarin group):

Survey of Citrus fruits bought in the markets of Ujung Pandang, Jakarta, Bandung etc. showed that the properties are practically the same as those we call Tankan and Ponkan in South Sulawesi. Among the fruits surveyed those of good quality were found to be originated from Bau-bau (South-east Sulawesi), Garut (West Java) and Kalimantan.

In Malang (East Java) and Bali we found a large size fruit which was flat shaped and with a peel-puffing tendency. Taste differed with each fruit. This last mentioned is called Jeruk keprok Batu in Malang and Mandarin in Bali. The Mandarin of Australian origin surveyed in September 1981 had a very good quality; originating in Queensland, the variety might be Ellendal or Beauty.

(4). Jeruk Besar:

We surveyed Jeruk besar originating from kabupaten Gowa and Pinrang. Fruit weight was 1,000 to 1,800 grams. The fruit was variously shaped, from obovoid with a shape index of around the 60-s to oblate with a shape index around the 120-s. Pericarp color varies as well, including white, pink, red etc. The pink and red ones generally have good taste. But the quality is inferior among those commonly called Pummelo group. Peel is very thick and pericarp ratio is as low as 50 - 60%.

(5). Other Citrus varieties:

The variety generally known as Jeruk Bandung and partially called Grapefruit is not sure to belong to Citrus pardisi Maf. This variety is mainly produced near Bandung, has large fruit weighing 250 - 350 grams which is oblate in shape. Peel is thin. The fruit is juicy and has a pericarp of good quality. Acid is fairly strong, but the juice squeezed out of the fruit taste good. The name Valencia was heard in several places, but no noteworthy fruit was found anywhere. Merely a Velencia from Kalimantan was found, with good quality, thin peel and much juice.

(6). The relation between coloring degree and sugar / acid:

Table 13 shows the result of sugar / acid test, classified by the peel color at the Citrus Contest in July 1981. The result showed no difference for sugar, but there was a difference of acidity in relation to the peel color. The more the peel color, the less acid and the taste was good with a high sugar/acid ratio. Results of three Tankan fruits of best color are added, namely, sugar 11.8 acid 0.7, sugar /acid ratio 16.8, and a good taste. As for the coloring index, the following marks are given: red - 10, dark orange - 8, orange - 6, yellow - 4, green - 2 for each fruit and afterwards the average figure was calculated.

Table 13. Relation between the coloring degree and the Sugar - Acid Ratio

	Fruit number	Peel color	Width mm	Height mm	Weight gr	Sugar	Acid	S/A ratio
	7	2.3	66.6	55.4	128	9.2	1.2	7.6
Tankan	7	5.9	68.0	56.3	138	10.0	0.9	11.1
	3	7.0	74.6	57.1	161	11.8	0.7	16.8
	3	2	68.0	59.0	151	8.9	1.0	8.9
Ponkan	3	4	67.2	58.6	150	8.7	0.7	12.4

V-5-3 Water Management of the Model Orchard.

In this region, excessive water is supplied by the heavy rain in the rainy season and the phenomenon of severe water shortage appears in the dry season. The soil is heavy clay and there is a pan in the lower layer. Drainage condition is very poor. In the dry season, cracks occur on the ground surface. In the model orchard, rain water in the tree hole is kept more than ten days without drainage in the rainy season, and in the dry season the ground surface becomes so hard that it cannot be dug by a hoe. Under this circumstance soil improvement and soil management by the use of cover crops and mulching are also important, but here we mention mainly about water management.

(1). Drainage measures in the rainy season (exclusion of harmful moisture):

Many Citrus orchards were found submerged during the rainy season, and it was found out that "footrot" disease was apt to occur in such submerged orchards because Phythophthora, the pathogenic fungus of footrot, was mediated by water and caused the disease parasitic on the part of root in contact with the ground surface. As Citrus roots require much air, the prolonged submergence may cause rotting of the roots and withering of the tree by the shortage of air. In the mature orchard, some trees without any sign of trouble were seen withered in the dry season and we inferred that such trees might be damaged at the root by submergence. Therefore, it is important to prevent submergence by constructing drainage canals and by using the trench method for planting instead of tree holes.

(2) Watering in the dry season:

As mentioned previously in V-5-1 as an example of quickened germination by watering, the watering in the dry season is effective to make the tree vigorous, to accelerate growth and to improve productivity.

1) Decision of watering quantity:

The watering quantity should be calculated with many factors like the degree of dryness, the soil condition (moisture retention ability), amount of transpiration from the Citrus tree and the ground, etc. But unfortunately, such factors are still unknown in this region. So some commonly used examples are given here:

a. In California, U.S.A., where rainfall is quite scarce, watering of 9,000 tons per ha. (equivalent to 900 mm.'s rainfall) will be necessary to get sufficient harvest.

b. Putting a number of examples in Japan together, 250 to 400 tons of water per ha. is given after 10 to 14 days without rain, and if it still goes on without rain, the same quantity is given after 7 to 10 days. In case of partial watering, quantity is one third the above. Water requirement of Satsuma mandarine (Citrus Unshiu) in Japan in the summer (hot and dry) season is said to be 35 to 40 tons per ha. per day to achieve normal growth.

2) Time of watering:

In order to know the proper time of watering in this region, the soil moisture in the model orchard has been measured by tension meter since May 1981 and the result is described in Figure 5. Explanation of Figure 5. will be given under item (3). Generally, when the tension meter indicates a reading of above 40, watering is necessary. In 1981, namely, the period between the later half of August and the first half of November was applicable. In 1980, there had been no rain since the end of June, so the reading of the tension meter might be over 40 in the first half of July. To improve fruit quality (increase of sugar content), it is expected to be dry around the level of P.F.3.5 (over 70 by tension meter); therefore no watering is required before harvest. But the moisture contained in the fruit is taken away by harvest and the tree trunk suffers by sudden water shortage. And several trees were seen withered by such suffering in 1980. In this connection it is necessary to give quite a large quantity of watering from a few days before harvest until just after that.

The field water capacity of heavy clay soil in this region seems to be higher in the deep layer, but no survey has been performed yet. Then it is necessary to continue the survey of the relation between the reading of the tension meter and the wilting condition of leaves in order to find a proper time of watering.

(3). Relation between the reading of tension meter and rainfall:

Figure 5. shows the figure of daily rainfall (vertical bar) and the reading of tension meter since May 1981. The curve of reading △-△-△ shows the available water at 10 cm. underground and the curve O-O-O shows that at 30 - 40 cm. underground. The higher the figure of reading, the drier the underground condition. The Terada method tension meter used in the model orchard indicates below 10 as wet, 10 - 40 as medium, and above 40 as dry. As for the soil in this region, the figure between 0 and 2 may be considered as excessive moisture. By the actual result of the soil in the model orchard in Tino,

a. From the wet condition in May 1981, soil began to change into the dry condition after about 20 days passed with no rain since the consecutive rainfall in the middle of May;
b. Soil condition turned to wet again with the rainfall around June 20 and continued to be wet until the middle of August becanse of the big rainfall in July;
c. The tension meter indicated above 40 which called attention for watering in the latter half of August when 20 - 25 days had passed without rain after consecutive rainfall in July;
d. When the drought continued, rainfall of about 20 mm. had no effect on the dry condition;
e. After consecutive dry condition, 50 millimeter of rainfall is necessary to change it into medium condition;
f. At the beginning of the rainy season, even consecutive rainfall seldom makes the wet condition below 10; and if a week goes by without rain the meter easily indicates above 30.
g. It was March 1982, near the end of the rainy season when the figure of reading became stable around 10.

4). Watering method in the model orchard (simple watering):

There are many methods of watering, namely furrow irrigation, basin irrigation, sprinkler system, etc.

In our model orchard, we have adopted the simple method of underground watering (partial wartering) using bamboo tubes in order to minimize the equipment cost and to fully utilize the small quantity of water. Please note that this method requires more labor to fill the bamboo tube with water, as compared to other methods. The bamboo with a diameter of 7 - 10 cm. is cut 40 - 50 cm. long with 3 knots. As described in the drawing, the knot at the bottom is kept (1) and the other knot is removed (2). The lower part below the bottom knot is sharpened in order to be easily stuck in the ground (3). Several cuts are made by a saw in the tube wall above the bottom knot (4) in order to let the water leak out through these cuts. For young trees, 4 bamboo tubes and for mature ones, 8 - 10 tubes are stuck under the tree crown.

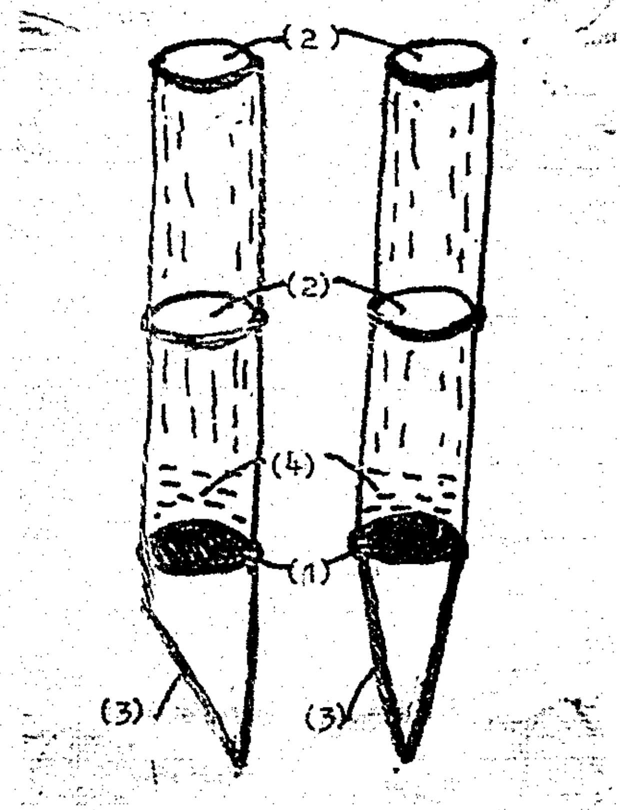


Fig. 5 - 1 ; Relation of Rainfall Soil Moisture
(May - August 1981)

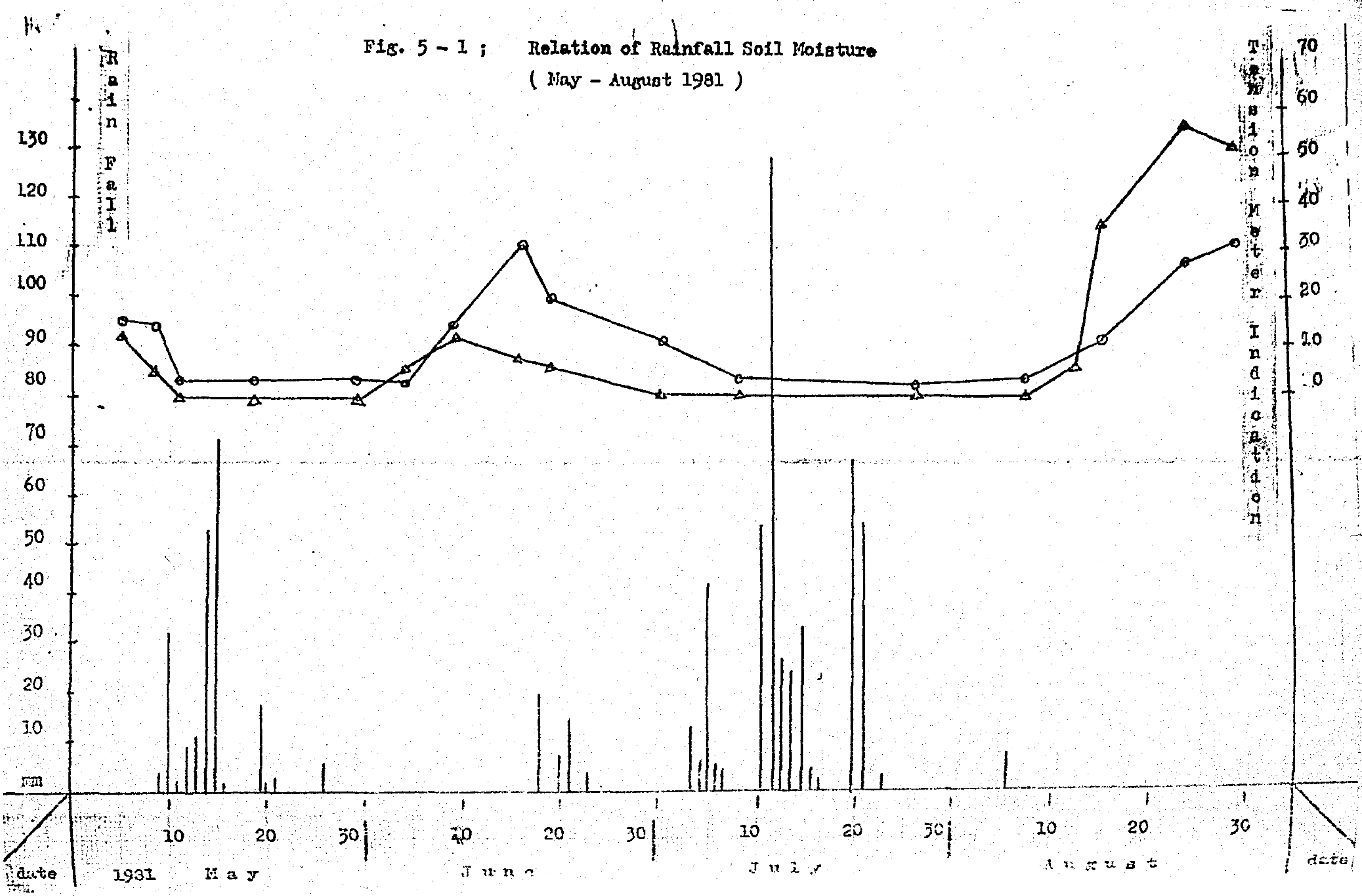


Fig. 5 - 2 ;   Relation of Rainfall and Soil Moisture

(September - December 1981)

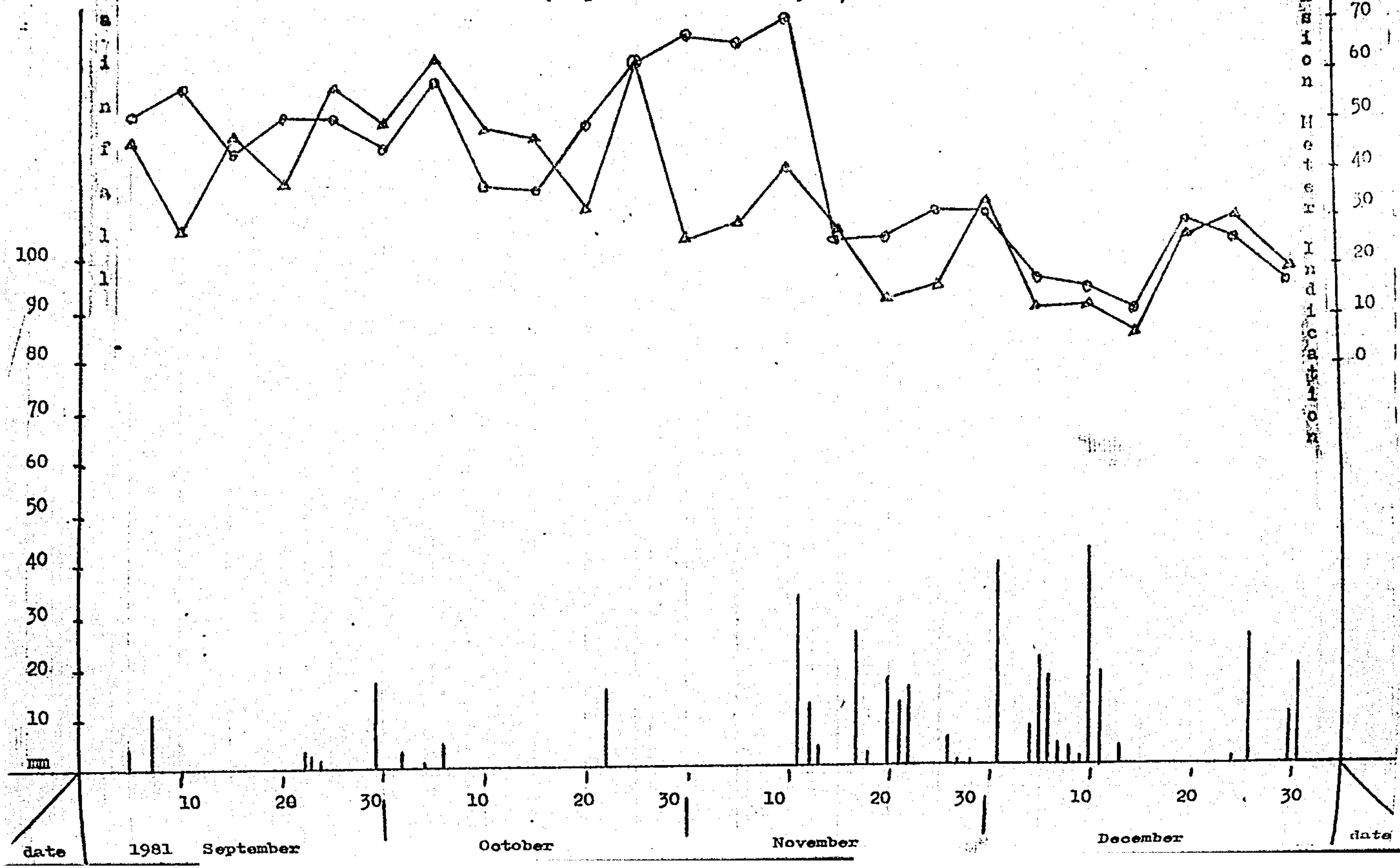
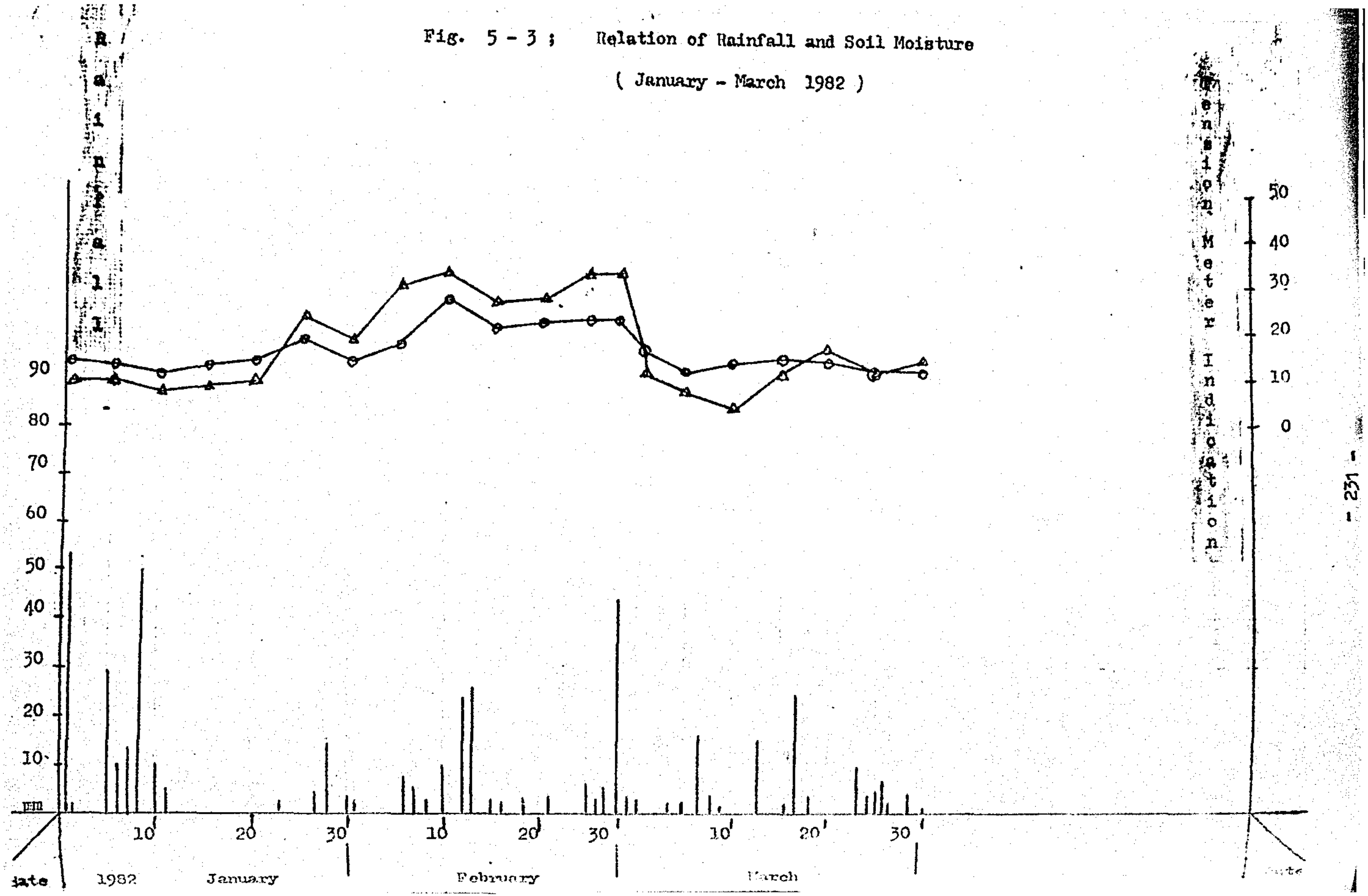


Fig. 5 - 3 ; Relation of Rainfall and Soil Moisture

(January - March 1982)



V-5-4 Improvement of the Propagation Technique.

Citrus trees in this region have been propagated mainly by seedlings so far, but from now on it is necessary to promote the grafting propagation positively for the purpose of striving for the progress of productivity and quality as a Citrus producing area.

(1). Why is grafting necessary?

Most of Citrus are poly-embryo. The parental character is relatively inherited even by seedling, but the asexual propagation by grafting is necessary to obtain the good individual of similar character. Especially the mono-embryo Citrus like Pummelos is common to have fruits of different characters grown from seedlings and the asexual propagation by grafting is an indispensable condition to get the individual of similar character. Therefore the seedling propagation seems to be the reason why Jeruk besar (Pummelo) in this region has various characters. When grafting is performed, it is recommendable to improve the disease tolerance and drought resistance of Citrus trees by selecting rootstocks of disease tolerance for virus and footrot, and of deep root and drought resistance. And it is also possible to adjust tree vigor by utilizing vigorous rootstock and dwarfing rootstocks.

(2). Rearing of rootstock:

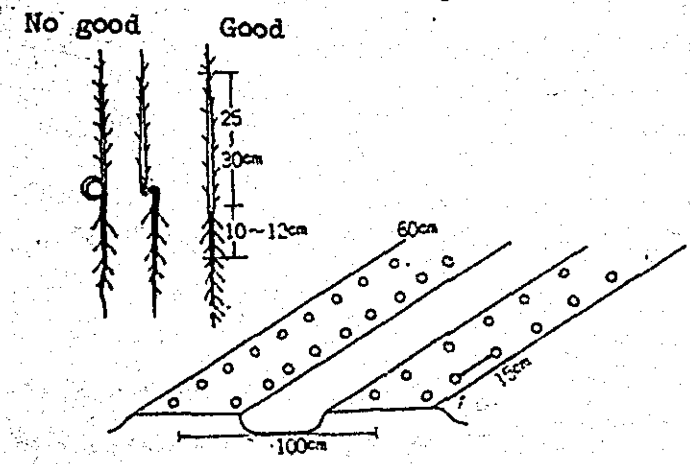
1) Rootstock variety of Tannin (Jeruk purut, Citrus histrix DC), which is mainly used as rootstock in this region nowadays, seems to be deep rooted, of affinity and relatively resistant to footrot. On the other hand, Rough Lemon is widely used as rootstock in Java and Bali. From now on it is necessary to continue for long the survey and research of rootstock concerning the affinity, drought resistance, disease tolerance and the effect on fruit quality.

2) Sowing: As the Citrus seed is very weak in dry condition, it is expected that the seed is sown soon after harvest. The repetitive use of the sowing bed will cause soil sickness and will worsen growth, so a shift of sowing bed will be required. Prior to sowing, sand and compost are mixed in the sowing bed. After sowing, mulching by grasses or rice straw is necessary to protect from drying, and watering is essential in the dry season.

3) Transplanting: The rootstock is transplanted in the nursery bed when it has grown about 20 cm. high, 4 - 6 months after sowing.

It is important to make the nursery bed fertile by applying sand, compost and basic fertilizer. Planting space is 1 meter's width of ridge and 15 cm's distance between stumps as shown in Figure 6. Two-line planting is convenient for the grafting work. In this case 13,300 seedlings can be planted per 0.1 ha. At transplanting, seedlings with curved roots are excluded and only the good seedling is used, such as described in Figure 6.

Fig 6; Nursery Bed



One third of the part of seedling above the ground is cut and the root is also cut shorter so as to be planted without bending it. During transplanting, it is important to prevent the seedling from drying by wrapping it in a wet straw mat or by another way.

4) Management of the nursery bed: After transplanting, mulching is done to protect from drying and watering is also performed sufficiently. In order to promote the growth, disease and insect control and fertilizer application are carried out when necessary. Especially there is much damage by the Citrus leaf miner, so insecticides like Nicotine sulphate, Isoxathion (Karphos), Dimethoate etc. should be sprayed in the period of leaf elongation with 10 days' interval. It is recommended that the fertilizer of N 60 kg., P 40 kg., K 30 kg. per 0.1 ha. is applied once in 1 - 1½ months. Besides, Tannin has vigorous growth of the lateral branch, so the topping of axillary buds is always recommended.

(3). Grafting :

1) Time : The grafting is possible when a period of about 6 months has passed since the transplanting of rootstock and the trunk diameter has become more than 7 millimeter. The proper time for grafting is the time when the scion is dormant and when the sap is circulating inside the rootstock, when peeling gets easier. And such a proper time for this region is the start of the rainy season, namely November and December. But our experience in the past two years shows that the take of scion after grafting is good regardless of the time, provided that the rootstock condition is good and sufficient watering is performed. As for the scion, it is important to take it from the fully-grown current shoot. The excellent mother tree is a prerequisite for scion (Please refer to the report on the first Citrus Contest regarding this point).

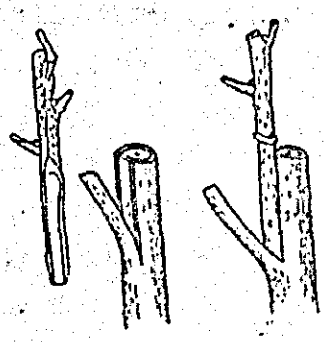
2) Grafting method : There are two ways of grafting, namely veneer-grafting and budding. The latter is recommendable for beginners because another trial is possible in case of failure. If this take of scion is good be veneer-grafting, the growth afterwards will also be good; therefore, veneer-grafting is recommendable for skilled hands. Both methods are illustrated in Fig 7. In the model orchard, Tannin seedlings were transplanted from February to April 1981 and side-grafting was performed to those seedlings in September-October 1981. The precentage of successfull take was very high and the subsequent growth was also very good. In this connection we would like to recommend for the orchard where Tankan and Ponkan seedlings are planted to do the side-grafting using the scion taken from excellent mother trees. This method can also be applied to the young tree within 10 years after planting (see Fig 8).

3) Post-grafting management :

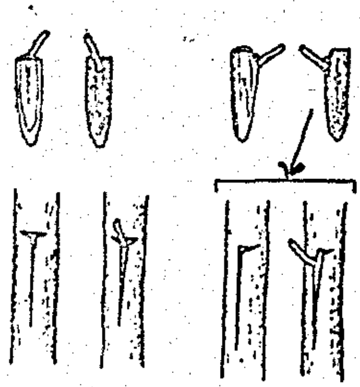
Removal of the vinyl tape ; The result of take (successful or not) can be judget 10 - 15 days after the grafting. When the bud has elongation by 2 - 3 millimeter, a small hole should be opened in the vinyl tape on the upper part of the bud in order to help elongation of the bud. Some people want to remove the vinyl tape early, but it should be kept until the bud elongates 3 - 5 cm. long. The reason is that the vinyl tape protects the bud and the graft union from drying and helps the formation of callus. Especially in case the graftinh is done in the dry season, this advice is essential and the vinyl tape should be kept for at least 1 - 1½ months.

Cutting off the rootstock ; In case the grafting is done in the rainy season it is better to cut off the rootstock above the graft union when the scion bud

Fig. 7 : Grafting Method

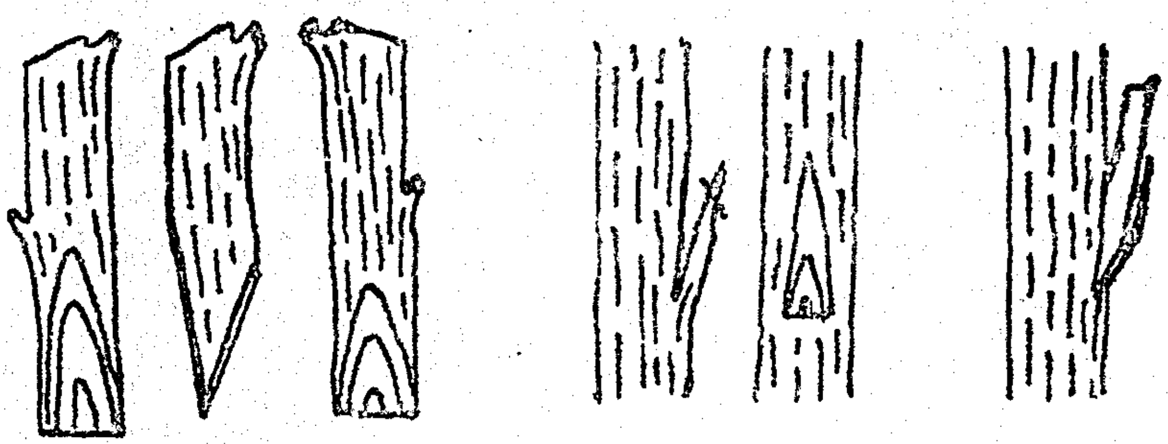


Venner-grafting



Budding

Fig. 8 : Side grafting



S c i o n

S t o c k

Side grafting

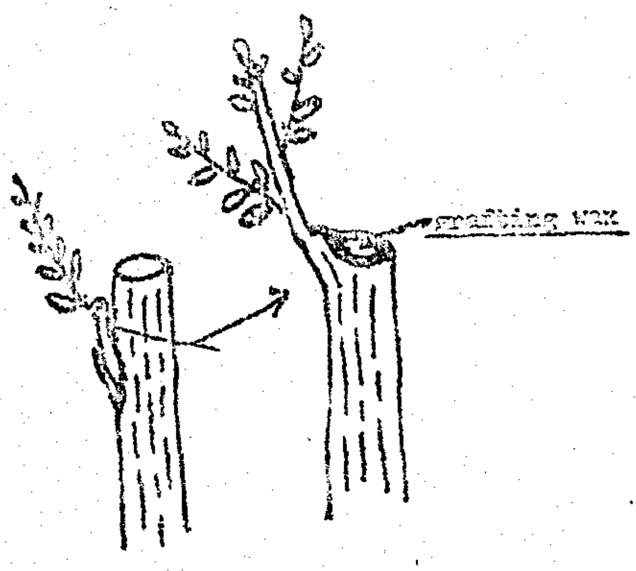


Fig. 9 : Cat Metherd of Stock

is taken and has started to grow because the cut off results in good subsequent growth. However, if the grafting is done in the dry season, even if the scion but is taken well, the short lenght of the rootstock should be cut (at 10 - 20 cm. above the graft union), retaining some leaves unless the new leaf from the scion bud has completed itself. There was an example in the model orchard that the grafted nursery plant withered on account of the early and thorough cut-off of the rootstock. The rootstock cut-off is performed as shown in Figure 9. and the grafting wax should be applied on the end. Other management: As the management after the take of scion, watering in the dry season, mulching, weeding, fertilizer application, disease insect control etc. are performed to promote the growth of nursery plant like the management of rootstock. And the bud of rootstock should always be removed.

(4). Record of the cultivation of grafted nursery plant.

1) Old nursery bed (Outside the model orchard)

i) Record of the progress of cultivation

July 1979 : Seed of Tannin, Tankan and Ponkan are sown

Feb. 1979 - Jan. 1980 : Transplanting, Tannin 35,000 trees, Tankan 15,000 trees and Ponkan 4,000 trees

Nov. 1980 onward : The training of grafting has been done

Feb. 1981 onward : The grafting has been carried out

ii) Number of grafted nursery plant

	No. of grafted nursery plant	No. of well-taken plant	Survival rate
Feb. - May 1981	abt. 1,000	abt. 400	40 %
June - Dec 1981	5,466	3,600	66
Jan. - Mar 1982	3,109	2,280	73
T o t a l :	9,575	6,280	66

(Note) :

The grafting has been continued in April 1982 onward and the variety of scion was Tankan and Ponkan

iii) Distribution of the grafted nursery plant

Transplanting in model orchard	169 trees (Oct - Nov 1981)
Supplementary planting in model orchard about	50 trees (Feb 1982 onward)
Distribution of farmers	3,444 trees (1,325 Dec 1981 and 2,092 Jan - Mar '82)

Distribution was made among the farmers in kab. Jeneponto, Bantaeng and Bulukumba who wished to have the grafted nursery plants. The remainder of grafted nursery plant are still being cultivated in the nursery bed.

2) New nursery bed (Model orchard Field No. 1)

i) The first cultivation

a. 450 of Tannin seedling sown in March 1981 and 300 of Nippis seedling sown in Oct. 1981 were transplanted in March 1982.

b. The scion of Japanese citrus varieties were grafted to the 189 Tannin seedlings in Feb - Mar 1982. Tankan and Ponkan were grafted to the other Tannin seedlings. Also Tankan and Ponkan were grafted to the 100 Nippis seedlings (As an experiment of affinity etc).

c. The seedlings of the various Indonesian varieties are being cultivated.

ii) The second cultivation

a. 62,000 seeds of Tannin were sown in July 1981. As the survival rate was about 70 %, now about 43,000 seedling are being cultivated.

b. The above-mentioned seedlings will be transplanted in the nursery bed prepared in Field No. 2 and No. 4 (the grafting will be practiced in 1983) Already 11,000 seedling have been transplanted in Field No. 2 in January 1982 onward.

c. In order to investigated the adaptability as a rootstock, the following varieties are sown in the part of nursery bed in Field No. 1, in March 1982.

Trifoliate orange (Poncirus trifoliata)
Rough Lemon (C. Jambhiri)
Mexican lime (Citrus Aurantifolia)
Yuzu (Citrus Junos Sieb)

V-5-5 Planting Method of the Nursery Tree

Once Citrus trees are planted they will continue production for several decades; therefore a careful selection of location is quite important for the establishment of new Citrus orchard. But our explanation here is confined to the planting method of the nursery tree.

(1). Preparation of the tree hole;

As an ideal, the preparation is arranged a half year before plant ing and the hole is filled with a mixture of soil, compost, fertilizer and lime. And the soil should be improved with a mixture of sand because the soil in this region is clay soil.

(2). Size of tree hole;

The standard size is 1m x 1m large x 1m deep. But in this region the deep soil has formed pan and the drainage condition is usually very poor. So the depth should be approximately 50 cm. so as not to cause water retention in the hole. The best method is to break the pan and to make the tree hole by trench method.

(3). Preparation of nursery tree;

The nursery tree with a thick trunk and well-developed lateral roots and rootlets should be selected. The purchased nursery tree is kept by provisional planting until the time for planting.

(4). Treatment of the nursery tree.

About one-third of the part above the ground is cut, making the lenght 50 - 70 cm. Tap root is cut short and rootlets damaged during transplanting is also cut just above the damaged part. As the Citrus root is weak in drying, it is important to wrap it in wet strawmat so as not to be dried up.

(5). Planting;

At the time of planting, care should be taken not to plant too deep in the ground. Especially the grafted nursery plant should be planted at the position that the grafting point is at least 10 cm. above the ground. If it is planted too deep, subsequent growth is hindered. In case the tree hole is prepared in advance, the refilled soil may sink afterwards so the soil should be piled up before planting. The root is spread in all directions with-out bending. Soil covering is arranged so that the soil covers the roots adequately. Sufficient watering will be performed after planting.

(6). Management after planting;

Beside sufficient watering, mulching is also arranged to prevent the soil from drying up. In the place of strong winds, the nursery tree is bound with a prop to prevent it from trembling.

V-5-6 The Second Citrus Contest in 198[illegible]

(1). Introduction.

For budgetary reasons this year we did not open an exhibition gathering all the exhibit at one time like the previous year. With the object of selecting the excellent mother tree, we practised inspection and judgment twice in July and August on the fruit samples picked from the candidates of mother tree. The schedule, number of exhibits and place of inspection are as follows:

First inspection	:
July 14 - 16	: Inspection of mother trees; picking 49 pieces of fruit
July 17 - 20	: Inspection and judgment of fruit.
Second inspection	:
August 20 - 21	: Inspection of mother trees; picking 18 pieces of fruit
August 22 - 24	: Inspection and judgment of fruit.

The place of inspection and judgment was the ATA-140 Project Office in Ujung Pandang. And this year we have also surveyed the candidates of mother trees in Kabupaten Bulukumba and Bantaeng.

(2). Result of Inspection.

The inspection was carried out by the same method as the previous year, but the number of seeds was not counted.

1) The time of the first inspection was one month earlier than the previous year, and furthermore, there was a difference in the weather condition, having much rainfall in June and July this year; therefore we found a marked difference as compared with the previous year, such as the following: (Refer to Table 14).

a. The size and weight of the fruit was larger than the preceding year. This may be caused by the fact that this year is the year of smaller production by biennial bearing, that the sample consist mainly of fruits of young trees, and that there was much rain in June and July But no peel puffing was found.

b. Peel color: the coloring degree this year is lower, with figures respectively 4.1 for Tankan and 2.5 for Ponkan, as compared with the figure of the preceding year, 5.9 for Tankan and 5.5 for Ponkan this may be due to picking at earlier date.

c. Sugar content (Brix): the value is quite lower than the previous year, for Tankan being 9.8 (previous year 13.1) and for Ponkan 8.7 (12.8 the previous year). These lower values seem to be largely influenced by the early picking and the rainfall and at the same time by the fact that the tree nutrition was not yet recovered from the wastage caused by the excessive bearing the previous year. The maximum value is: Tankan 11.0 (previous year 16.0), Ponkan 10.1 (13.9) and the minimum value is Tankan 8.8 (10.5), Ponkan 8.1 (11.2).

d. Acid content: It is higher than the previous year, For Tankan being 1.1 (previous year 0.9) and Ponkan 0.9 (0.7), and this may be due to the picking that was one month earlier. The maximum value is Tankan 2.0 (previous year 1.4) and Ponkan 1.2 (1.0), while the minimum value is Tankan 0.7 (0.5) and Ponkan 0.5 (0.5).

2) On August 20 - 21, the inspection on mother trees and picking of fruit were carried out for the second time. As for Ponkan, the harvest was finished in the middle of August in Kecamatan Bontotiro of Kabupaten Bulukumba, so the samples were taken from the remaining fruit except for receipt no. 4 from Mr. Achmad. The 3 trees in Desa Tino of Kabupaten Jeneponto were in the proper time of harvest. As for Tankan, the 3 trees in Desa Tino were in the proper time of harvest. Fruit of trees in Desa Bajiminasa, of Biang Keke in Kabupaten Bantaeng were premature and small in size because the blooming was in March and it was rather late (receipt no. 14 - 18). Consequently, based on the result of 4 Ponkan trees and 3 Tankan trees, we report the comparison with the results of previous year and the first inspection this year as follows:
(Refer to Table 15).

a. Tankan has enlarged in size as compared with that at the first inspection, while its weight has become 158 grams, 38% higher than that in July. Ponkan, however, has enlarged a little. Degree of fullness is good, except for one case of peel puffing of Ponkan.

b. Peel color has advanced from the first inspection, and the figures are respectively: Tankan 7 (first inspection 4.1), Ponkan 4.4 (2.5). Particularly Tankan has developed the orange color. In comparison with the preceding year, the peel color of Tankan is better than the preceding year and that of Ponkan is worse.

c. Sugar content was anticipated to increase but actually Tankan shows no change and Ponkan shows a slight increase from 8.7 at the first inspection to 9.7. In comparison with the previous year, these values are rather low, probably because of the wastage of tree nutrition due to excessive bearing in the previous year as mentioned before.

d. Acid content: Tankan shows a sharp decline with-in one month and the value is 0.6 (1.1 at first inspection). The value decreased slightly for Ponkan, i.e. 0.7 (0.9). Acid content at second inspection was nearly the same as that previously.

(3). General Judgment.

1) Basis of judgment:

Certain number of marks are given to each item as follows:

a. Shape (10 marks): judged by the shape and uniformity of exhibit.

b. Peel color (10):

100% of the fruit in the nice color	-- 10 marks
10 % not having a nice color	-- 8
20 % " " " "	-- 6
30 -40 % " " " "	-- 4
morethan 40 % " " " "	-- 2

c. Injury by insects and disease (15)

No injury by insect / disease	15 marks
Few traces of injury by insects / disease :	
- Only 3 - 5 fruits injured	-- 13 marks
- About all fruits injured	-- 10
Extent of injury by insect / disease	
- Moderate	-- 7
- Large	below 5

d. Sugar content (20)

Brix	Marks
More than 12.0	20
11.9 - 11.0	19
10.9 - 10.5	18
10.4 - 10.0	17
9.9 - 9.5	15
9.4 - 9.0	13
8.9 - 8.0	11

Brix	Marks
7.9 - 7.0	9
Below 6.9	6

Total = (65 marks)

Results gained on the above basis are explained as follows and in Tables 16 - 17.

2) In spite of the bigger fruit size, such as mentioned before, the uniformity is generally good except for a few pieces. The fruits are full and merely one peel puffing is found at the inspection in August.

3) In July the peel color is worse than the previous year, as most fruits show green or yellowish green color with several good ones of orange color. In August, the coloring degree has advanced and is nearly same as that the previous year.

4) Injury by insects and disease: the most remarkable injury is the adherence and traces of adherence of scale insects. Secondly, the trace of insect bite, the lesion of sooty disease and scab-like disease and scratches by wind are noted. Some exhibits damage their commercial value with the injury by insects and diseases, while the injury is of a slight degree. If chemical spraying is applied several times a year, the commercial value of fruits is sure to be uplevelled.

5) Taste : Sugar content being much lower in comparison with that in previous year, only few fruits have as rich a taste as previous year. But the taste is good in general. There are some fruits having a plain taste, especially in August. The juice is found in August.

6) Number of seeds: Although the number of seeds was not counted this year, we found in the fruit as many seeds as in previous year. As the seeds exert a harmful influence on the taste, it is quite important to reduce its number or to grow seedless fruit for the future progress of Citrus industry in this region. It is urgently needed to select the variety of such better taste and to propagate it by grafting.

7) According to the result of the contest, we mention here the names of kampung-s producing the good quality Citrus fruit;

J u l y : Tankan - Kanang-kanang of Desa Tino
Desa Paitana Kecamatan Binamu;
Ponkan - Desa Paitana Kecamatan Binamu;
Pacinongan of Desa Tino

August : Tankan - Pacinongan of Desa Tino
Ponkan - Kecamatan Bontotiro of Kabupaten Bulukumba.

(4). Result of Taste Survey.

After the first inspection in July, a simple taste survey was carried out with staff members of Kanwil Deptan, using fruit exhibits.

1) The survey method is as follows:

a. The receipt number is marked on each fruit, and fruits are mixed together

b. About 15 pieces are picked from the mixture of fruits and given to each of staff members.

c. Every staff member grades the sample fruit into three categories of sweet, less sweet and sour and gives the following report the following day:

R e p o r t f o r m

Citrus Taste Survey

Please take one fruit with any number on it

Fruit Number	T e s t Number	Sweet	T a s t e Less sweet	S o u r

25 persons were asked to conduct a survey and finally 16 reports were received. The result of the survey is as follows: (Please note that this survey is too simple and too rough to evaluate the people's taste of Citrus).

2) Response to Sweet / Sour (Figure 10):

In Figure 10, the sugar content (Brix) is shown along the vertical axis and the acidity is shown along the horizontal axis . The mark • indicates the response of Sweet and mark x indicates the response

Fig; 10 Mutual Fig. of Sweet and Sour

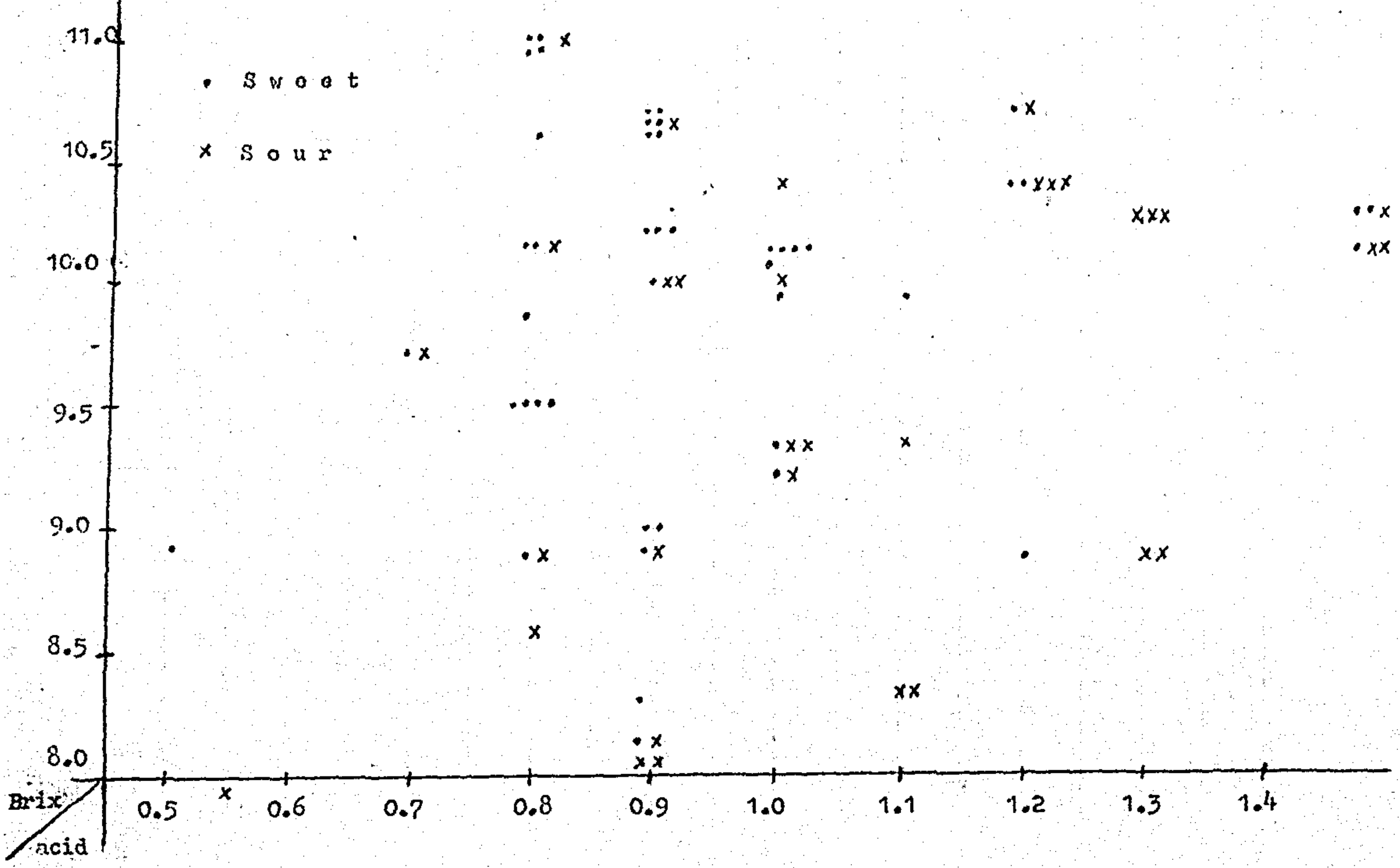
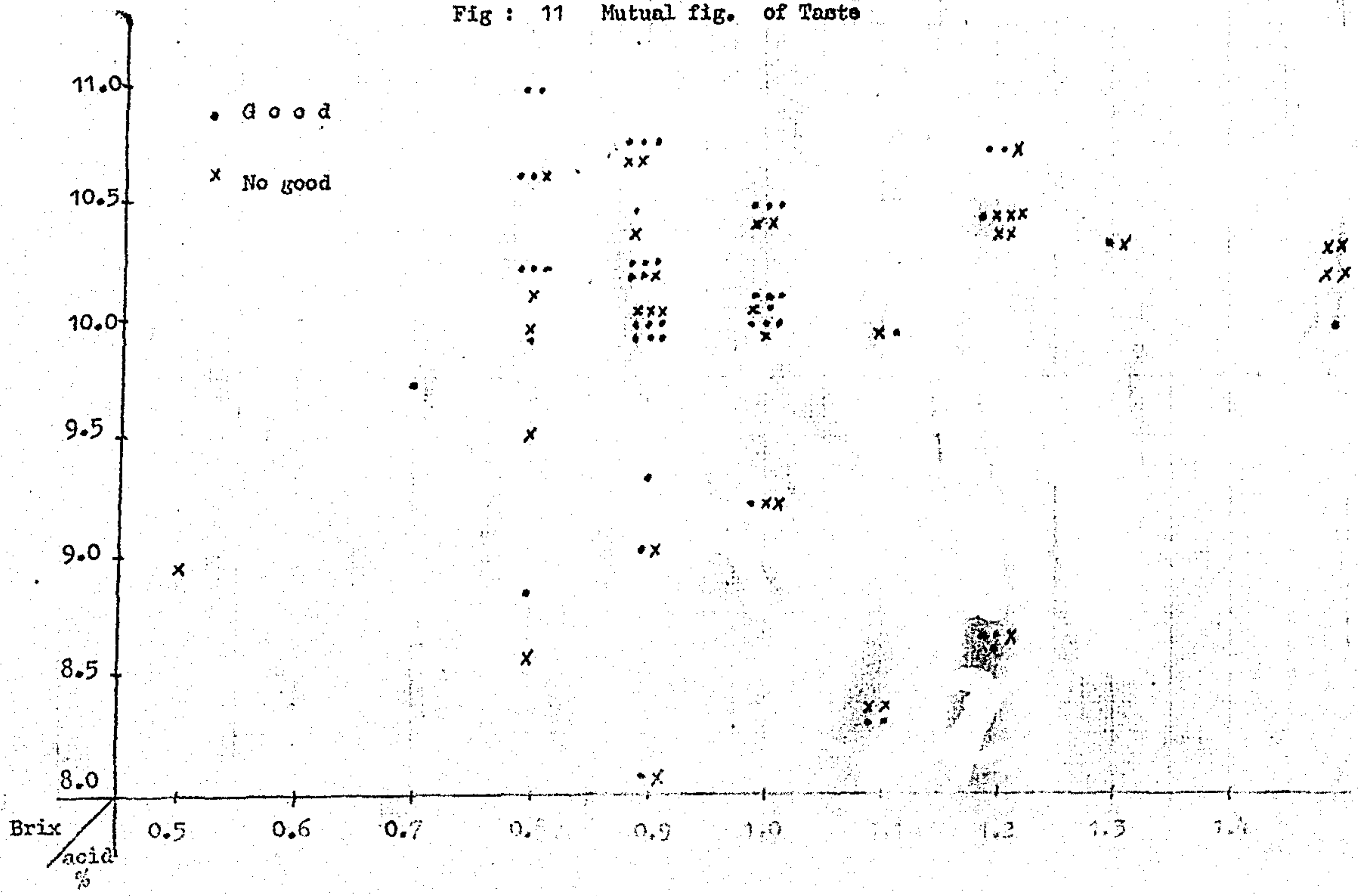


Fig : 11 Mutual fig. of Taste



of Sour. According to this result, people generally sense a sweetness by Brix above 10 and acidity below 1.0%, and has a strong sense of a sour taste by acidity above 1.1%. But in case Brix is lower, the response of sour is shown even by an acidity less than 1.0%. In case of Brix above 10, if acidity exceeds 1.2%, sour response appears more.

3) Response to Taste (Figure 11):

The vertical/horizontal axis is set as Figure 11. Mark shows three high marks of taste from the top and mark x shows three low marks from the bottom. According to this result, the response of good taste ranges mostly from Brix of above 10 to a acidity of 0.8 - 1.0%. But there is a response of unsavory taste in case of such a combination as Brix above 10 and acidity over 1.2%, Brix around 9 and acidity below 0.6%, and Brix and acidity both very low.

4) Discussion:

The above-mentioned is just one result done in July 1981 when the sugar content was very low. If we had performed a survey in 1980 when the majority of sugar content was above 12 and the average was 13.1, we would have received different responses on the taste, sugar and acidity. In Japan, the fruit within the range of Brix above 12 and acidity of 0.8 - 1.1% are appreciated as having a good taste. It is hoped that Citrus fruits in this region will have Brix 12 at the lowest. Besides, there is the sugar-acid ratio (Brix acid) as an index of taste and this value would desirably be above 1.0. Incidentally, the value for Tankan was 1.31 in 1980 and 0.89 in 1981.

(5). Selection of Candidate Elite Mother Tree

By the result of the Citrus Contest of 1981, the following Citrus trees have been chosen as candidates of mother tree. From now on, the survey of these trees will be continued and it is anticipated that for the time being scions for propagation will be taken from these trees until the mother tree is officially designated.

Candidate of Elite Mother Trees and Names of Owners

	Receipt No.	Tree No.	Address	Name	Age of Tree
1. TANKAN					
First judgment	3	I	Kanang-kanang Tino	Dullah	7
	4	II	ditto	Dullah	7
	5	I	ditto	H. Daming	12
	6	II	ditto	H. Daming	12
	7	I	ditto	H. Rabanti	7
	29	I	Paitana	Sinjai	10
	31	I	Paitana	Limpo	10
Second judgment	11	II	Pacinongan - Tino	Darusi	8
	12	III	Ditto	Darusi	8
	13	III	ditto	Salèh	8
2. PONKAN					
First Judgment	27	II	Paitana	Pasara	12
	40	I	Pacinongan - Tino	Nasrum	8
	41	II	ditto	Nasrum	8
	45	I	ditto	Hasan Rati	8
	47	III	ditto	Hasan Rati	8
Second judgment	1	I	Tiro-tiro, Ka-lumpung	Natsir	8
	2	II	ditto	Natsir	8
	3	III	ditto	Natsir	8
	4	I	ditto	Ahmad	7
	7	I	Pacinongan - Tino	Darusi	8
	8	I	ditto	Saleh	8
	9	II	ditto	Saleh	8

Table 14. - (1) The first Inspection of the Fruit Variety : Tankan (1)

Kampung	No. of Receipt	Size: Width (mm)	Size: Height (mm)	Size: Shape index	Weight: Whole (gr.)	Weight: Pericarp (gr.)	Weight: Pericarp ratio	Peel Color	Sugar (Brix)	Acid Content
Kanang TINO	1	70.1	58.7	119	144	124	82	2.6	8.8	1.2
	2	69.8	56.1	124	152	132	83	2.6	8.8	1.3
	3	66.1	51.8	128	122	105	87	3.2	10.4	1.0
	4	70.1	58.9	119	157	132	82	4.2	10.2	0.8
	5	67.1	56.4	119	137	114	83	4.2	10.6	0.8
	6	66.2	52.6	126	127	106	86	3.2	10.3	0.9
	7	67.2	56.1	120	131	113	86	5.2	10.0	1.0
	8	66.0	54.9	120	127	109	86	5.4	10.0	0.9
	A.V	67.8	55.7	122	137	117	84.4	3.8	9.9	1.0
Bt.Katanga TINO	10	69.4	59.3	117	146	125	82	3.4	9.7	0.7
	11	77.8	56.8	137	181	162	83	7.8	9.3	0.9
	12	65.7	52.8	124	117	105	83	8.0	9.8	0.8
	13	65.7	55.1	119	130	114	85	2.6	9.2	1.0
	14	66.9	57.3	117	137	118	85	3.0	9.9	0.9
	A.V	69.1	56.3	123	142	125	83.6	5.0	9.6	0.9

Note : A.V = Average.

Table 14 - (1) The first Inspection of the Fruit Variety : Tankan (2)

Kampung	No. of Receipt	Size: Width (mm)	Size: Height (mm)	Size: Shape index	Weight: Whole (gr)	Weight: Pericarp (gr)	Weight: Pericarp ratio	Peel Color	Sugar (Brix)	Acid Content
Bt. Hasugi										
Taroang	15	68.4	56.6	121	139	118	84	6.0	10.7	1.2
	16	73.3	60.2	122	172	154	83	6.8	9.9	1.1
	A.V	71.1	58.4	122	156	136	83.5	6.4	10.3	1.2
Bolongloe										
Tolo	17	66.9	53.9	124	129	105	84	3.0	10.4	1.2
	18	65.5	52.9	124	126	117	86	3.4	10.3	1.2
	19	62.6	49.2	127	104	90	82	2.2	10.0	1.2
	20	61.2	49.8	123	99	85	84	2.0	10.5	1.5
	21	62.4	51.0	122	102	84	84	2.0	11.0	2.0
	22	64.2	50.9	126	112	94	79	2.4	10.2	1.6
	23	63.9	51.7	124	110	90	83	1.6	10.3	1.5
	A.V	63.8	51.3	124	112	95	83.1	2.4	10.4	1.5
Lanting										
Gantorang	25	71.9	58.7	122	152	126	82	3.8	9.4	1.0
	A.V	71.9	58.7	122	152	126	82	3.8	9.4	1.0

Note : A.V = Average.

Table 14 - (1) The first Inspection of the Fruit. Variety : Tankan (3)

Kampung	No. of Receipt	Size Width (mm)	Size Height (mm)	Size Shape index	Weight Whole (gr.)	Weight Pericarp (gr.)	Weight Pericarp ratio	Peel Color	Sugar (Brix)	Acid Content
Paitana	26	68.4	54.8	125	140	116	85	6.4	10.7	0.9
	28	64.8	54.0	120	119	106	84	6.0	9.9	0.9
	29	69.2	54.8	126	143	125	85	6.0	10.2	0.9
	30	68.1	53.5	127	132	115	84	3.8	9.5	0.8
	31	74.8	56.2	133	164	127	81	7.6	11.0	0.8
	32	64.9	51.9	125	123	108	84	2.8	9.9	1.0
	A.V	68.3	54.2	126	137	116	83.8	5.4	10.2	0.9
Bt. Sungguh Kab. Banta-eng	33	71.3	58.2	123	167	145	88	3.8	8.8	0.9
	37	68.8	54.6	126	143	125	85	6.0	9.1	0.9
	38	70.1	60.0	117	162	145	85	1.0	9.3	1.0
	39	64.2	54.4	118	126	111	88	3.0	8.3	1.0
	A.V	68.6	56.8	121	159	132	86.5	3.5	8.9	1.0

Note : A.V = Average.

Table 14 - (1)   The first Inspection of the fruit   Variety : Tankan (4)

Kampung	No. of Receipt	Size Width (mm)	Size Height (mm)	Size Shape index	Weight Whole (gr.)	Weight Pericarp (gr.)	Weight Pericarp ratio	Peel Color	Sugar (Brix)	Acid Content
Pacinong-an, Tino	42	64.2	56.2	114	121	99	85	4.6	9.3	1.0
	43	64.9	53.5	121	120	102	86	4.8	9.8	1.4
	44	59.2	50.3	118	99	93	88	2.8	9.5	1.2
	46	68.5	62.1	110	151	123	83	3.0	9.3	1.1
	48	58.1	49.2	118	96	81	84	2.6	9.8	1.3
	49	58.5	50.9	115	95	78	86	5.6	9.8	1.3
	A.V	62.3	53.7	116	114	96	85.3	3.9	9.6	1.2
Total	A.V	66.8	54.8	122	133	113	84.2	4.1	9.8	1.1
1980	A.V	59.4	46.7	127	95	80	83.5	5.9	13.1	0.9

Note : A.V = Average.

Table 14 - (2) The first Inspection of the fruit Variety : Ponkan (1)

Kampung	No. of Receipt	Size Width (mm)	Height (mm)	Shape index	Weight Whole (gr)	Pericarp (gr.)	Pericarp ratio	Peel Color	Sugar (Brix)	Acid Content
Bt. Katanga, Tino	9	81.9	66.3	124	212	143	71	3.4	7.8	0.6
Lantang Gantarang	24	73.2	63.1	116	178	141	77	2.4	8.8	0.8
Paitana	27	70.8	62.8	113	174	145	80	2.8	10.1	1.0
Bt Sungguh Kab. Banta-eng	34	67.8	61.9	109	158	128	79	1.0	9.0	0.9
	35	67.9	58.9	115	147	108	81	2.6	8.9	0.5
	36	69.7	57.7	121	152	130	83	2.4	8.4	0.7
	A.V	68.5	59.5	115	152	122	81.0	2.0	8.8	0.7
Pacinongan Tino	40	74.9	62.7	119	185	132	73	4.6	8.3	1.1
	41	65.8	58.4	113	146	107	79	2,0	8.8	1,2
	45	72.5	63.8	114	182	138	78	2.0	9.0	0.8
	47	63.4	53.5	118	121	95	79	2.0	8.1	0.9
	A.V	69.2	59.6	116	159	118	77	2.7	8.6	1.0
Total	A.V	70.9	60.9	116	166	127	78.0	2.5	8.7	0.9
1980	A.V	64.9	55.2	117	132	105	74.7	5.5	12.8	0.7

Note : A.V = Average.

Table 15 - (1) The second Inspection of the Fruit . Variety : Ponkan.

Kampung	No. of Receipt	Size: Width (mm)	Size: Height (mm)	Size: Shape index	Weight Whole (gr.)	Peel Color	Sugar (Brix)	Acid Content
Kalumpang Kab. Bulukumba	1	64.0	56.6	113	133	2.0	9.1	0.5
	2	63.3	56.9	111	131	2.2	10.0	0.6
	3	62.3	53.6	116	118	2.4	8.1	0.5
	4	73.7	61.5	120	117	5.6	9.7	0.5
Buhung Lantang Kab. Bulukumba	6	58.8	57.7	102	112	2.0	8.0	0.6
Pacinongan TINO	7	72.9	61.9	118	185	4.4	10.0	0.7
	8	72.7	61.5	118	168	5.0	10.0	0.8
	9	71.6	61.9	116	171	2.4	9.0	0.6
	A.V	72.4	61.8	117	175	3.9	9.7	0.7
No. 4, 7, 8, 9	A.V	72.7	61.7	118	175	4.4	9.7	0.7
The fast Inspection.	A.V	70.9	60.9	116	166	2.5	8.7	0.9
1 9 8 0	A.V	64.9	55.2	117	132	5.5	12.8	0.7

Note : A.V = Average.

Table 15 - (2) The second Inspection of the Fruit Variety : Tankan

Kampung	No. of Receipt	Size Width (mm)	Size Height (mm)	Size Shape index	Weight Whole (gr.)	Peel Color	Sugar (Brix)	Acid Content
Pacinongan TINO	11	72.9	53.0	137	164	8	10.0	0.6
	12	72.4	56.8	127	159	8	9.4	0.5
	13	68.5	55.6	123	152	5	9.8	0.7
	A.V	71.3	55.1	129	158	7	9.7	0.6
Bajiminasa Kab. Bantaeng	14					2	8.3	1.1
	15					2	10.2	1.1
	16					2	10.0	1.4
	17					2	9.8	1.4
Biang Keke Kab. Bantaeng	18					2	9.7	1.3
	A.V					2	9.6	1.3
No. 11 - 13	A.V	71.3	55.1	129	158	7	9.7	0.6
The fast Inspection.	A.V	66.8	54.8	122	133	4.1	9.8	1.1
1 9 8 0	A.V	59.4	46.7	127	95	5.9	13.1	0.9

Note : A.V = Average.

Table 16.- (1) The first Judgment Sheet Variety : Tankan (1)

No. of Receipt	Shape (10)	Peel Color (10)	Pest and Disease (15)	Taste (10)	Sugar Content (20)	Total (65)	Order	Kampung	Desa	Kecamatan	Kabuoaten
1	8	2	13	8	11	42		Kanang[2]	Tino	Batang	Jeneponto
2	8	2	12	7	11	40		"	"	"	"
3	6	3	10	9	17	45		"	"	"	"
4	10	4	13	9	17	53	I	"	"	"	"
5	8	4	12	6	18	48	IV	"	"	"	"
6	10	3	13	5	17	48	IV	"	"	"	"
7	10	3	13	6	17	49	III	"	"	"	"
8	6	3	11	8	17	45		"	"	"	"
10	4	2	12	7	15	40		Bt.Katanga	"	"	"
11	10	5	8	9	13	45		"	"	"	"
12	8	5	11	8	15	47	V	"	"	"	"
13	6	2	12	7	13	40		"	"	"	"
14	8	2	12	8	15	45		"	"	"	"

Table 16 - (1)

The fast Judgment Sheet

Variety : Tankan (2)

No. of Receipt	Shape (10)	Peel Color (10)	Pest and Disease (15)	Taste (10)	Sugar Content (20)	Total (65)	Order	Kampung	Desa	Kecamatan	Kabupaten
15	6	3	9	8	18	44		Bt.Masugi	Taroang	Batang	Jeneponto
16	10	4	11	8	15	48	IV	"	"	"	"
17	6	2	10	7	17	42		Borongloe	Tolo	Kelara	"
18	8	2	13	8	17	48	IV	"	"	"	"
19	6	2	11	8	17	44		"	"	"	"
20	6	2	12	5	18	43		"	"	"	"
21	6	2	13	5	19	45		"	"	"	"
22	6	2	11	6	17	42		"	"	"	"
23	6	1	7	7	17	38		"	"	"	"
25	8	2	12	8	13	43		Lantang	Gantarang	"	"
26	8	3	8	9	18	46		Bonto reban	Paitana	Binamu	"
28	8	3	10	8	15	44		"	"	"	"
29	10	3	13	8	17	51	II	"	"	"	"

Table 16 - (1) The fast Judgment Sheet Variety : Tankan (3)

No.of Receipt	Shape (10)	Peel Color (10)	Pest and Disease (15)	Taste (10)	Sugar Content (20)	Total (65)	Order	Kampung	Desa	Kecamatan	Kabupaten
30	8	3	10	9	15	45		Paitana	Paitana	Binamu	Jenoponto
31	10	4	7	9	19	49	III	"	"	"	"
32	6	2	10	6	15	39		"	"	"	"
33	8	3	10	8	11	40		Bt.Sungguh	Bt.Sungguh	Bisappu	Bantaeng
37	8	3	8	8	13	40		"	"	"	"
38	8	1	11	8	13	41		"	"	"	"
39	6	2	11	7	11	37		"	"	"	"
42	6	2	9	9	13	39		Pacinongan	T i n o	Batang	Jeneponto
43	6	3	8	8	15	40		"	"	"	"
44	4	2	10	5	15	36		"	"	"	"
46	8	2	11	8	13	42		"	"	"	"
48	4	2	10	6	15	37		"	"	"	"
49	4	3	11	6	15	39		"	"	"	"

Table 16 - (2) The first Judgment Sheet Variety : Ponkan

No. of Receipt	Shape (10)	Peel Color (10)	Pest and Disease (15)	Taste (10)	Sugar Content (20)	Total (65)	Order	Kampung	D e s a	Kecamatan	Kabupaten
9	6	2	5	6	9	28		Bt,Katanga	T i n o	Batang	Jeneponto
24	4	2	4	8	11	29		Lantang	Gantarang	Kelara	"
27	10	2	9	9	17	47	I	Paitana	Paitana	Binamu	"
34	8	1	8	8	13	38	IV	Bt.Sungguh	Bt.Sungguh	Bisapu	Bantaeng
35	6	2	8	7	11	34		"	"	"	"
36	8	2	8	7	11	36		"	"	"	"
40	10	2	12	8	11	43	II	Pacinongan	T i n o	Batang	Jeneponto
41	8	1	12	7	11	39	III	"	"	"	"
45	10	1	13	6	13	43	II	"	"	"	"
47	6	1	13	7	11	38	IV	"	"	"	"

Table 17 - (1)

The second Judgment Sheet

Variety : Ponkan

No. of Receipt	Shape (10)	Peel Color (10)	Pest and Disease (15)	Taste (10)	Sugar Content (20)	Total (65)	Order	Kampung	Desa	Kecamatan	Kabupaten
1	6	2	13	6	13	43		Tiro-tiro	Kalumpung	Bonto tiro	Bulukumba
2	6	2	12	7	17	47	IV	"	"	"	"
3	6	3	10	5	11	38		"	"	"	"
4	8	8	12	8	15	55	I	"	"	"	"
6	6	2	10	5	11	37		"	Buhung Lantang	"	"
7	8	6	12	7	17	54	II	Pacinongan	Tino	Batang	Jeneponto
8	6	7	10	8	17	51	III	"	"	"	"
9	8	5	8	8	13	46	V	"	"	"	"

Table 17 - (2) The second Judgment Sheet Variety : Tankan

No. of Receipt	Shape (10)	Peel Color (10)	Pest and Disease (15)	Taste (10)	Sugar Content (20)	Total (10)	Order	Kampung	D e s a	Kecamatan	Kabupaten
11	8	9	10	9	17	57	I	Pacinongan	T i n o	Batang	Jeneponto
12	10	9	10	8	13	55	II	"	"	"	"
13	10	6	7	9	15	52	III	"	"	"	"
14	4	2	6	5	11	30		Ujung Bata	Bajiminasa	Tompo Bulu	Bantaeng
15	4	2	6	6	17	37		"	"	"	"
16	4	3	6	5	17	37		"	"	"	"
17	4	1	6	5	15	33		"	"	"	"
18	4	1	5	5	15	32		Pajukuang	Biang Keke	"	"

V-5-7 Meteorological Observation.

As the equipment supplied before are scattered in many places and some of them are insufficient, meteorological observations cannot be conducted satisfactorily. Observation of rainfall was started in December 1980 when the equipment started to be supplied; observation of humidity was carried out from April 1981 when the instrument screen was installed.

(1). Temperature.

Observation of temperature was commenced in May 1981, using the maximum and minimum thermometer and the monthly average is mentioned in Table 18. The monthly range is 1 - 4^{o} and the daily range (Difference between maximum and minimum) is about 10^{o}. The extreme of maximum temperature is 35^{o} and that of minimum temperature is approximately 20^{o}. As regards the temperature, we do not think of any special harmful effect on the growth of Citrus trees.

(2). Humidity.

Results of the observation carried out by means of a psychrometer at 6 a.m. and 2 p.m. since April 1981 is described in Table 18. Humidity is high in the morning, i.e. 80 - 90%, and is around 70% in the daytime. The daily range is bigger in the rainy season.

(3). Evaporation.

The observation is started from August 1981, using the small-sized evaporimeter, and the result is described in Table 18. As the observation is not performed through one year, it is rather risky to make a comment on the seasonal change. According to this table, the amount of evaporation is large in August - October, being 7 - 8 mm a day in the dry season and decreasing to 5 mm a day after November as rainy days increases.

(4). Rainfall.

Table 19 shows the result of observation in the model orchard since December 1980, the result of observation conducted by the Agricultural Extension Service of Kabupaten Jeneponto in 1980 and 1981 and the average result of ten years', 1970 - 1979. In this region, rainfall has its biggest influence on the growth of Citrus trees and the fruit thickening, and moreover, rainfall varies greatly by location and by year. Therefore the data of the Agricultural Extension Service and 10 years' average are added here for comparison. As mentioned in Table 19, in the model orchard in 1981 there was rain every month, the amount of rain in a year was 1,678 millimeter which was abundant; in July, which was the dry season, 15 days' rain of 464 mm. was recorded. Annual rainfall at the Agricultural Extension Service located 20 km. to the west of the model orchard is 971 mm., exceeding the average figure of 10 years. Particularly the 106 mm. rain of July is 2.5 times as much as the figure of 10 years' average, there is the record of 1.306 mm. of annual rainfall in 1975 among observation data of the Extension Service. As mentioned above, there was much rain in 1981, more than the average year, but in 1980 the rain was quite sparse in various places of Kabupaten Jeneponto. Record of the Extension Service shows there was entirely no rain during three months' period; July, August and September 1980. Rain in October amounted to 5 mm. (the 30th), while it was 1 mm. by November 26 and 4 mm. by November 30. it was practically the same as no rain, Consequently in 1980 we saw plenty of withered trees in various places in Kabupaten Jeneponto, and germination and blooming were delayed. In 1981 leaf wilting was slightly seen but withered trees were few. Germination and blooming were earlier than the previous year (Refer to V-5-1: Ecology of Citrus trees).

Table 18. Temperature, Humidity and Amount of Evaporation

Month	Temperature		Humidity						Amount of evaporation mm.
			6:00			14:00			
	Max.	Min.	Dry	Wet	Hum. %	Dry	Wet	Hum. %	
4			24.3	23.2	91	29.7	26.6	78	
5	31.0	24.3	25.4	24.0	88	29.2	26.8	81	
6	30.6	22.5	23.5	22.4	91	29.8	26.2	75	
7	30.0	22.1	25.2	22.8	80	27.6	24.7	77	
8	30.6	22.0	24.9	22.7	82	29.9	25.8	72	7.4
9	30.0	22.4	25.7	22.9	78	30.2	25.5	68	7.7
10	32.9	21.7	25.8	24.0	86	31.5	26.2	63	8.2
11	32.7	21.7	26.1	22.8	73	30.8	25.7	66	5.4
12	33.7	22.1	26.7	24.8	84	29.8	26.0	72	5.3
1	32.7	20.8	26.8	23.9	77	29.5	26.3	78	5.2
2	32.1	20.8	26.4	24.3	84	30.2	25.8	72	3.8
3	30.9	20.9	26.6	24.5	84	30.9	27.6	78	4.5
4	31.9	20.7	25.9	23.7	82	30.2	26.7	75	5.1

Table 19. Rainfall At the Project Site and at the Kabupaten Jeneponto Agricultural Extension Service

	Project site Tino		Kab. Jeneponto Agr. Ext. Service Pakkaterang		
	1981	1982	1980	1981	Average '70 - '79
1	142/21	199/18	166/18	193/24	196/14.0
2	152/14	147/18	126/19	131/12	116/14.7
3	187/13	111/23	28/10	79/9	126/12.5
4	84/7	216/21	55/8	6/5	35/3.5
5	179/12	–	47/8	44/7	41/5.5
6	45/4	–	59/10	13/4	65/7.2
7	464/15	–	–	106/15	40/2.5
8	8/3	–	–	–	6/0.7
9	39/9	–	–	2/2	12/0.5
10	23/5		5/1	8/2	21/2.2
11	136/12	–	5/2	140/13	36/5.0
12	219/16	*168/17	133/17	250/17	115/11.5
Total	1678/131		624/93	971/110	809/79.3

Note : * December 1980.

Rainfall (mm) / Number of days

V-6 Operational Plan for the model Orchard at the Citrus Pilot Test Site in future

V-6-1 Basic Policy.

The basic policy for the operation of the model orchard is as follows:

(1). To establish a model Citrus orchard utilizing the technology of cultivation applicable to the Citrus industry in the region.

(2). To demonstrate the technology of cultivation for the improvement of productivity and quality, and to conduct experiments for the practice of cultivation.

(3). To conduct ecological surveys for the basis of cultivation.

(4). To conduct trainings on various technology.

(5). To produce and distribute grafted nursery plants of good quality.

V-6-2 Outline of Tables and Figures

Table 20 : Summary of the purpose and the present condition of each field.
Table 21 : The ecological change of Citrus trees and the monthly work schedule are described here.
Table 22 : Survey items of each field are planned for the period of 1982 - 1986.
Figure 2 : Land-use Map of the Citrus model orchard.

V-6-3 Purpose and Operational Plan of each field

(1) Field 1-(1) - Nursery bed.

1) Purpose :

a. Experiment for the improvement of grafting technique;
b. Collection and comparative study (including affinity test of rootstock)
c. Training of the grafting technique;
d. Distribution of grafted nursery plants of good quality.

2) P l a n :

About 600 m^2. of the northern end of this field which is a 50 cm. high terrace will be mainly used as sowing bed and nursery bed of the important varieties. About 1,000 m^2. plot at the southern border of the above-mentioned part will be used as a transplanting bed and the grafted nursery plants will be grown here for about 1½ years. Continuous cropping should be avoided in this bed. Tannin seedlings sown in July and August 1981 will use the part of Fields 2 and 4 where water supply is adequate for a transplanting bed. But the period for the use of Fields 2 and 4 should be limited within about 3 years of young age.

(2) Field 1 - (2) - Exhibition Field.

This field is a wet lowland and the condition is not so good; therefore, various kinds of Citrus and other fruit trees will be planted here for exhibition.

(3) Field 2 - (1) - Collection of Citrus varieties.

1) Purpose :

To collect and preserve the main domestic and foreign Citrus varieties, to conduct a comparative study on varieties and to select the good mother tree for propagation.

2) Plan :

As Tannin seedlings are already planted here, grafting will be performed when the scion of various varieties are available. Scions will also be taken from seedlings of many varieties which are now being grown in the nursery bed when they are mature enough to be taken as scion.

N. B. The record book and the row planting map should be prepared to keep record of the grafted nursery plant concerning the name of variety, route of introduction, date of grafting, condition of tree growth, condition of fruit bearing, etc.

(4) Field 2 - (2) - Ecological research.

1) Purpose :

To investigate mainly the affinity between the scion and the rootstock of different varieties in order to select the suitable rootstock variety.

2) Plan :

For the time being, scions will be of the main varieties of the region, namely Ponkan, Tankan and Jeruk Besar, while as rootstock will be Jeruk Tannin, Jeruk nipis and free stock. (Refer to the following table of combination).

Combination of scion and rootstock

Scion / Stock	Tankan	Ponkan	J. Besar
T a n n i n	◎	◎	◎
N i p i s	◎	◎	◎
T a n k a n	o	-	-
P o n k a n	-	o	-

N o t e : 1. The mark ◎ is very important.
2. Seedlings of each variety should be grown for comparison.

Moreover, when the rootstock of rough lemon (*Citrus Jambihiri* Lush), Trifoliate Orange (*Poncirus trifoliata* Rnf.) is ready, Ponkan, Tankan and Jeruk besar will be grafted to such rootstock. Seedlings of Trifoliate Orange are being grown now.

(5) Field 3 - Pest control test.

1) Purpose :

Test for the control of insect and diseases, especially to select suitable pesticides and insecticides and to find the proper time of control.

2) P l a n :

The test plot will be arranged as follows:
East-west planting row No. 1-8 for insect control;
" " " " No. 9-15 for disease control;
" " " " No. 16 for comparison (without control).

Note: As for Phythophthora, the kind of rootstock and the position of grafting will be investigated.

(6) Field 4 - (1) - Model Management field.

1) Purpose :

This field will be kept in the best condition of management as a model.

2) P l a n :

The main points of management are as follows:
During the period of young tree, the soil management like weeding, mulching, fertilizer application, chemical spraying, training,

pruning, disbudding, irrigation in the dry season, wind control etc. are performed to accelerate growth. Later, for the growth of the adult tree and for the adjustment of bearing, training, pruning, fertilizer application, chemical spraying, soil management, fruit thinning to adjust biennial bearing will be performed.

(7) Field 4 - (2) - Pruning test.

1) Purpose :

To investigate the influence of training, pruning and fruit thinning on tree growth, fruit production and fruit quality.

2) P l a n :

The test plot will be arranged by different degrees of training and pruning, and also by the different time of performance for comparison.

(8) Field 5 - Fertilizer and soil management test.

1) Purpose :

To investigate the relation between the growth of the Citrus tree fruit production, fruit quality and fertilizer application and soil management.

2) P l a n :

The test plot will be arranged as follows :

a. Without fertilizer;

b. With 3 elements (N-P-K) and with Nitrogen only;

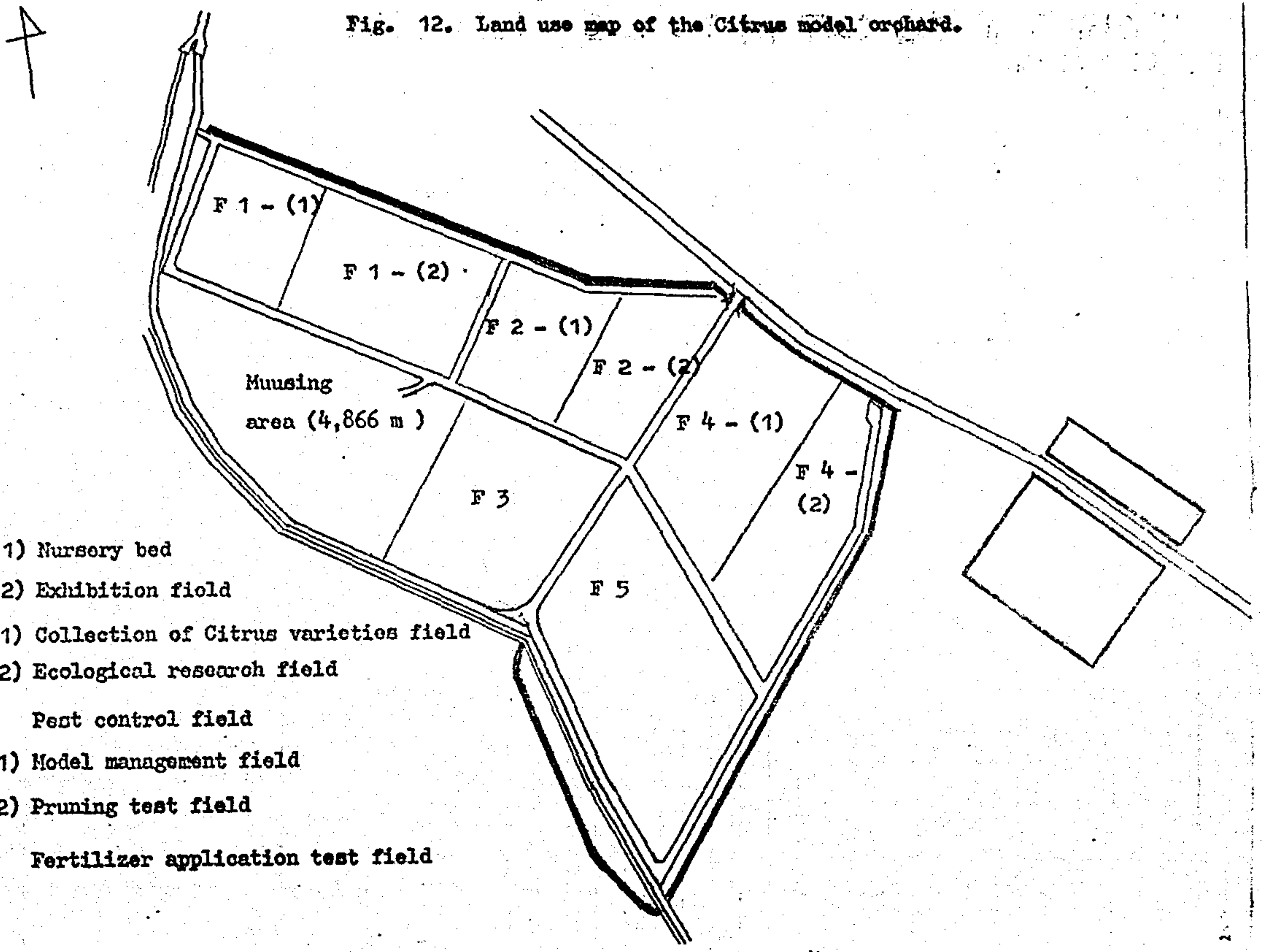
c. With compound fertilizer;

d. With mulching.

Table 20. The Purpose and the Present Condition of Each Field.

Field Number	Area m	P u r p o s e	Planted tree variety	Planting Date
1- (1)	1,580	Nursery bed		
1- (2)	2,800	Exhibition field		
2- (1)	2,320	Collection of Citrus varieties	92 Tanning seedlings	
2- (2)	1,050	Ecological research	8 trees, grafted Ponkan 8 Ponkan seedlings 8 Tankan seedlings 33 Tannin seedlings	April 8 - 13, 1981
3	3,840	Pest control set	76 Tankan seedlings	March 18, 1981
			68 Grafted nursery plants	December 25, 1981
4- (1)	2,600	Model management field	104 Tankan seedlings	Feburary 18 - 19 1981
4- (2)	2,330	Pruning test	101 Tannin seedlings	
5	5,150	Fertilizer application and soil management test	55 Ponkan seedl. 43 Tannin seedl.	March 25 - 31 1981
			93 Grafted nursery plants	Dec. 25, 1981

Fig. 12. Land use map of the Citrus model orchard.



F 1 - (1) Nursery bed

(2) Exhibition field

F 2 - (1) Collection of Citrus varieties field

(2) Ecological research field

F 3 Pest control field

F 4 - (1) Model management field

(2) Pruning test field

F 5 Fertilizer application test field

Table 21. The ecological change of Citrus tree and the monthly working schedule

	12	1	2	3	4	5	6	7	8	9	10	11	12
Ecological change													
germination & blooming		germination & elongation of current shoot continues until the middle of dry season.											
elongation of root		(It starts a little later than that of the part on the ground)											
physiological fruit drop													
growth and ripening of fruit													
occurence of pest													
Working practice													
mowing, weeding	(Done through the year)				Especially in these months								
application of herbicide								(Before the start of rainy season)					
mulching	(Beware of elosion)												
application of fertilizer													
spray of chemicals													
1) citrus leaf miner	Elongation period of current shoot of nursery plant, once in 7-10 days, Nicotine Sulfate or Isoxathion												
2) scales					(dimethoate or Isoxathion)								
3) disease							(Streptomycin or Benomyl)						
training, pruning	(at any time)												
disbudding											(mainly for young tree)		
sprinkling of water													
measure for wind-break													
fruit ~~thinning~~													
harvesting													
maintenance of field				(at any time, as occasion demands)									

Table 22. Survey plan of each field in 1982 - 86 onward.

Items \ Year	1982			83	84	85	86	'	
	1-3	4-6	7-12						
Field 1 - (1) Nursery bed									
Growth of rootstock	0	0	0	0					trunk diametor, elongation
Grafting	0								
Survival rate		0							
Growth of grafted nursery plant.			0	0	0	0	0	→	trunk diameter (10 cm above grafting position), elongation.
Field 2 - (1) Collection of Citrus Vr.									
Grafting of each citrus variety	0	0	0	0	0				soon after the introduction of variety
Research on property (tree)		0	0	0	0	0	0	→	growth, germination, blooming time, etc.
Research on property (fruit)							0	→	thickening, yield, quality, etc.
Making of row planting map	0								
Field 2 - (2) Ecological research									
Preparation of test tree	0	0							
Research on property (tree)		0		0	0	0	0	→	growth, germination, blooming, etc.
Research on property (fruit)							0	→	thickenin , yield, quality, etc.

Year / Items	1982 1-3	1982 4-6	1982 7-12	83	84	85	86	'	
Field 3 Pest control test :									
Setting of test plot	0								
Judgment of effect		(Done at each time of spray)							
Ecological survey of pest	0	0	0	0	0	0	0	→	Done in order of importance
Field 4 - (1) Model orchard :									
Ecological survey				0	0	0	0	→	Growth of tree, blooming, yield, etc.
Field 4 - (2) Pruning test :									
Setting of test tree		0							
Quantity of Pruning			0	0	0	0	0	→	Occurence of current shoot, growth of tree etc.
Time of pruning				0	0	0	0	→	Just before rainy season, in rainy season, end of rainy season
Pruning method				0	0	0	0	→	Growth of tree, yield, etc.
Fruit thinning							0		Yield, quality of fruit, etc.
Field 5 Fertilizer, Soil Management test :									
Setting of test plot	0								
Judgment of effect				0	0	0	0	→	Growth of tree, etc.
Survey on yield/ quality							0	→	
Meteorological survey	0	0	0	0	0	0	0	→	Temperature, rainfall, humidity, etc

CHAPTER VI. ECONOMIC AND FINANCIAL JUSTIFICATION OF MODEL PROJECTS

This report is made by Mr. Hidetoshi Takama, JICA short-term expert of agricultural economics, with the assistance of the team members of ATA-140 project.

Contents

CHAPTER VI. ECONOMIC AND FINANCIAL JUSTIFICATION OF MODEL PROJECTS

VI-1. Model Project of Citrus Orchard.

VI-1-1. Projections of production and demand :

In Phase II the ATA-140 Team projected the future production of citrus in 1979, but at present the forecast figures are likely to be biased from the reality due to the inevitable hazards such as drought and to some optimism.

The projections of the whole South Sulawesian production is a difficult task because of the scarce data which provide merely numbers of planted and harvested trees from 1974 to 1979. Moreover, due to severe drought, some of the existing trees are assumed to have died (10 to 20% have been said to be damaged). Although further studies concerning the production in this area should be made, the conventional method was used to find out the future trends of production, such as the following :

(1). Yearly productions of citrus are shown in Table 1.

Table 1. Productions in South Sulawesi

Year	Amount (ton/metric)
1974	2,685
1975	3,048
1976	4,165
1977	5,311
1978	5,072
1979	8,891
1980	22,145

(2). The future tendency was calculated from the above data through the least square method. The equation is,

$$y = 2008 \times (1 + 0.336)^t \qquad (r = 0.827)$$

where y = production
t = year ; $t = 0$; 1974

This formula suggests that the growth rate of production is 33.6% a year. The production amounts are compounded year by year at the rate of 0.336.

(3). As mentioned above, the further sophisticated projection of supply should be made by the method in which numbers of planted, existing and harvested trees should be aggregated by their maturities.

Keeping eyes to the demand of citrus for consumers, it is obviously very high. Additionally, the price of this fruit at present is high in comparison with other agricultural commodities.

Estimates of the demand for this commodity were made by projecting population increases and increase in per capita consumption with rising real income in the Province. The other factors like changing taste of the population, migration, etc. were not taken into account in this projection.

The per capita demand growth is shown in the following formula :

$$\frac{\Delta D}{D} = \frac{\Delta P}{P} + \eta \frac{\Delta I}{I}$$

where $\frac{\Delta D}{D}$ = growth rate of per capita demand

$\frac{\Delta P}{P}$ = population growth rate

η = income elasticity of demand

$\frac{\Delta I}{I}$ = income growth rate

t = year.

Now, $\frac{\Delta P}{P} = 0.0275$, $\frac{\Delta I}{I} = 0.076$, $\eta = 0.9$

Then, $\frac{\Delta D}{D} = 0.0959$

It is assumed that η is a bit higher than the FAO's estimate of 0.8 which is an average figure of several fruits including citrus, bananas and other tropical fruits. The FAO's figure, however, was calculated for an average per capita income class so that if the average income increases significantly, it would decrease. Nevertheless, in this projection, this figure ($\eta = 0.9$) was assumed constant.

According to the former ATA-140 Team, projected per capita demand of Citrus fruits in 1970 was 3.3 kg. If the growth rate of population in the Province comes along with the following formula which was worked out from " Statistik Indonesia " (1978/1979), the rate is 2.75% a year.

$$P_t = 5,657,000 \times (1 + 0.0275)^t$$

$$(r = 0.997)$$

where P_t = population in t-th year.

$t = 0$ is in 1976

Therefore, the total demand in t-th year was obtained from the following equation,

$$d_t = 3.3 \text{ (kg.)} \times 5,657,000 \text{ (persons)} \times \left(1 + \frac{\Delta D}{D}\right)^t$$

$= 3.3 \times 5{,}657{,}000 \times (1 + 0.0959)^t$,

where d_t = total demand

t = 0 in 1976.

The projected total demand and production is shown in the following figure.

Table 2. Projected Demand and Production in South Sulawesi

Unit : ton.

Year	Projected demand	Projected Production
1970	15,863	-
1974	22,881	2,008
1980	39,637	11,418
1985	62,654	48,600
1986	68,663	64,929
1987	75,247	86,746
1990	99,039	206,855

In the projections, the increasing rate of the production is assumed to be much greater than that of the demand. Therefore, in the future the production amount will exceed the demand.

VI-1-2. Price Forecasting :

The data concerning it are so scarce that it would be difficult to assume the future price tendency. It has been attempted to find out the relation between the past trends of prices and productions but there was no significance. In 1980, the average retail price in Jeneponto was Rp 210/kg. although that year was good in terms of harvest.

Table 3 shows the retail prices both in Jeneponto and in South-Sulawesi.

Although July, August and September are the peak months of production, in the short run i.e. one-year long, there has been no significant difference among prices; but in three years in South Sulawesi they rose up gradually. Consequently, the price elasticity of supply may be low.

Moreover, the marketing structure is so complicated that there are three main sources of flow into the wholesale market in Ujung Pandang.

Table 3. Retail Prices of Citrus

(Unit : Rp/kg.)

Month	Jeneponto	South Sulawesi		
	1980	1976	1977	1978
1	210	60	135	188
2	215	55	176	344
3	210	165	135	281
4	210	65	160	313
5	210	70	126	273
6	210	98	136	273
7	210	90	160	225
8	210	103	184	254
9	205	140	258	231
10	205	160	180	226
11	200	100	214	281
12	210	95	294	265

Source : Agricultural Extension Service of Kabupaten Jeneponto.
South Sulawesi Province Agricultural Extension Service.

First, fruits are flowed into the market through middlemen. Secondly, " ijon " systems hold the marketing channels from harvest to wholesalers. Thirdly, big merchants (mainly 4 are said) hold the channels. This means that the market may be going to a monopoly situation where prices may be distorted and be kept at a high level.

In the following analysis, Rp 200/kg. was taken for convenience, but for assuring the risk, i.e. significant price declines under the coming overproduction, sensitivity analysis was made. Price decline was assumed at 20% and 40% annually.

VI-1-3. Calculation on the model project :

Although there are no data which show concrete past performance of citrus production either year-wise or region-wise, it is clear that the production has a tendency of rapid growth. It is considered that the determination of the price has nothing to do with the expansion of the citrus production so far, and that the farm-gate and retail prices are much different.

Therefore, there must be marketing problems which are likely to violate the market mechanism.
The benefit should be shared by not only the producers and middlemen but the consumers.

Model : The most serious problem for citrus entrepreneurs in the southern part of South Sulawesi is how to get irrigation water to their plants during severe dry seasons.
The model applies simple water-saving irrigation system with an engine-pump.

Then, the comparison between " with " and " without " project is made. They are shown in table 6 and 7.
The term is taken 12 years for financial analysis and the discount rate is 12% per annum which is drawn from the long-term interest rate in this country. Then, the Benefit / Cost Ratio and Net Present Value were calculated in the following table.

Table 4. Present values and B/C ratios :

(x 1,000 Rp).

	With :	Without :	Increment :
Present Value of Cost	73,419	34,578	38,841
Present Value of Benefit	296,811	189,476	107,335
Net Present Value	223,392	154,897	68,495
B/C Ratio	4.04	5.48	2.76

Although the B/C Ratio of "without" is higher than that of "with", the net present value of " with " exceeds that of " without " by Rp.68,495, 000,-.
The B/C ratio (increment) is 2,76 so that the project is financially feasible.

Under the present economic circumstances, both of the future price of citrus and the future cost are so uncertain that the sensitivity analysis was done in the following table.

In the analysis, the sensitivities are 20% and 40% hike of the cost, and 20% and 40% decrease of citrus, i.e. Rp.16,- and Rp.12,- per piece respectively.

Even in the most unfavorable situation ; 40% up of the cost and 40% down of the citrus price, the B/C ratio is 1,18 over one.

This implies that this project is feasible even in the such economic situation.

Table 5. Sensitivity analysis on N.P.V and B/C ratios

(x 1,000 Rp.)

		Cost Hike	
		20% up	40% up
Price	20% Down	39,259 (1,84)	31,491 (1,58)
Decrease	40% Down	17,792 (1,38)	10,024 (1,18)

Note : (B/C Ratios).

Table 6. Farm models with 30 ha.

Dimension : One stock is planted in 6 x 4 m.

ITEMS :	WITH :	WITHOUT :
1. Investment Cost		
i. Nursery stocks	1) Grafted nursery plants 6,000 trees @ Rp.500,-	1) Only seedlings 12,000 trees @ Rp.200,-
	2) Seedlings 6,000 trees @ Rp.200,-	2) Same as 3).
	3) Nursery stocks are prepared for supplemental plantings and replanting in 6th, 9th, 12th, 15th, years.	
ii. Machines & Implement.	1) Pump and accessary discharge 380 1/m 4 HP 10-year depreciation @ Rp. 524,000,-	1) N o n e.
	2) Power sprayers 7-year depreciation 1 for 0 to 6th year, 3 for 7th year to last @ Rp.476,000,-	2) N o n e.
	3) Implement including hoses etc.	3) Small-scale implement.
Production Cost	1) Application.	No application.
i. Fertilizers.	(g/tree).	

	N	P_2O_5	K_2O
Base	50	30	20
1st yr	100	50	30
2 - 4	200	100	70
5 - 7	300	180	120
8 -11	400	300	160
12 -15	500	400	250

ITEMS :	WITH :	WITHOUT :
	2) Urea, TSP, synthetic fer. also applied.	
ii. Compost.	Application.	S a m e.

Base	10 kg./tree
1 - 4 yr.	10 kg./tree
5 up to	20 kg./tree

<table>
<tr><th>ITEMS :</th><th>WITH :</th><th>WITHOUT :</th></tr>
<tr><td>iii. Chemicals</td><td>1) Apply nicotine sulphate, karphos etc. against citrus leaf mainer, 4-5 times/yr, up to 4th. yr.
2) Apply insectcide, fungicide twice a year from 5th year
3) Application amount :

| | per tree | per ha. |
0 | 150 cc | 60 l
1 | 500 | 200
2 | 2,000 | 800
3 | 5,000 | 2,000
4 | 7,000 | 2,800
6 | 10,000 | 4,000
9 | 15,000 | 6,000
13 | 18,000 | 7,200</td><td>N o n e.</td></tr>
<tr><td>iv. Water</td><td>1) Water-saving method; a sort of drop-irrigation using bamboo trunk.
2) Water requirement ; 20 l/ 3 days/ tree, i.e : 80 t/ day/ 30 ha.
3) Period ;

Aug. - Oct. 90 days
Nov. - May 20 days
June - Sept. 10 days
T o t a l : 120 days

4) Fuel ;
i. Pump operation hour ; 80 t = (0,38 x 60) = 3,5 hrs/ day.
ii. Fuel ccnsumption 0,84 l/hr x 3,5 hrs. = 2,94 l/ day.
iii. Lubricant 10% of diesel price.
iv. Cost of diesel oil ; @ Rp.85,-/ l.</td><td>Apply only when planting.</td></tr>
</table>

ITEMS :	WITH :	WITHOUT :
3. Labor Cost	1) Pruning, chemical control, thinning, weeding and - plowing : Labor input 100 - 190 men/ ha./ day @ Rp.750,-/ man/ day.	1) Weeding and plowing; labor input 50 - 70 men/ ha./ day.
	2) Harvest : 1,500 piece/ man/ day @ Rp.750,-/ man/ day.	2) S a m e.
4. T a x	1) Land tax : Rp.5000,-/ha.	S a m e.
	2) Income tax : Rp. 1,-/ piece.	

Table 7. FINANCIAL ANALYSIS ON "WITH" AND "WITHOUT"

(unit = 1,000 Rp.)

YEAR *	INVESTMENT COST					
	Nursery stocks		Machines & Implement		Sub - Total	
	With	Without	With	Without	With	Without
0	4,200	2,400	1,184	125	5,384	2,535
1	0	0	0	0	0	0
2	0	0	0	0	0	0
3	0	0	52	0	52	0
4	0	0	0	0	0	0
5	0	0	240	0	240	0
6	600	240	52	0	652	240
7	0	0	1,350	0	1,350	0
8	0	0	0	0	0	0
9	600	240	52	0	652	240
10	0	0	764	66	764	66
11	0	0	0	0	0	0
12	600	240	0	0	600	240
13	0	0	52	0	52	0
14	0	0	0	0	0	0
15	600	240	240	0	840	240

YEAR	LABOR COST							
	Planting		Cultivation		Harvest		Sub - Total	
	With	Without	With	Without	With	Without	With	Without
0	3,000	3,000	1,500	750	0	0	4,500	3,750
1	0	0	1,500	750	0	0	1,500	750
2	0	0	1,500	750	0	0	1,500	750
3	0	0	1,650	820	0	0	1,650	820
4	0	0	1,800	900	120	0	1,920	900
5	300	240	2,100	1,000	400	400	2,800	1,640
6	0	0	2,250	1,000	680	120	2,930	1,120
7	0	0	2,250	1,000	1,000	1,000	3,250	2,000
8	300	240	2,400	1,000	1,600	400	4,300	1,640
9	0	0	2,400	1,000	2,000	2,400	4,400	3,400
10	0	0	2,550	1,000	1,800	200	4,350	1,200
11	300	240	2,550	1,000	2,400	2,800	5,250	4,040
12	0	0	2,700	1,000	2,000	200	4,700	1,200
13	0	0	2,700	1,000	2,800	2,800	5,500	3,800
14	300	240	2,850	1,000	2,400	200	5,550	1,440
15	0	0	2,850	1,000	3,200	2,800	6,050	3,800

YEAR	PRODUCTION COST									
	Fertilizer		Compost		Chemicals		Water		Sub - Total	
	With	Without	With	Without	With	Without	With	Without	With	Without
0	84	84	240	240	230	---	33	100	587	424
1	263	84	240	240	230	---	33	-	766	324
2	441	210	240	240	570	---	33	-	1,284	450
3	441	210	240	240	1,420	---	33	-	2,134	450
4	441	210	240	240	1,650	---	33	-	2,364	450
5	863	430	288	288	1,650	---	33	10	2,834	728
6	863	430	288	288	2,700	---	33	-	2,884	718
7	863	430	288	288	2,700	---	33	-	3,884	718
8	1,250	625	288	288	2,700	---	33	10	4,271	923
9	1,250	625	345	345	2,900	---	33	-	4,528	970
10	1,250	625	345	345	2,900	---	33	-	4,528	970
11	1,250	625	410	410	3,340	---	33	10	5,033	1,045
12	1,614	807	460	460	3,340	---	33	-	5,447	1,267
13	1,614	807	460	460	4,080	---	33	-	6,187	1,267
14	1,614	807	460	460	4,080	---	33	-	6,187	1,267
15	1,614	807	460	460	4,080	---	33	10	6,187	1,267

YEAR	TAX						Grand Total of Cost		Benefit	
	Land		Income		Sub - Total					
	With	Without	With	Without	With	Without	With	Without	With	Without
0	150	150	0	0	150	0	10,621	6,709	0	0
1	150	150	0	0	150	0	2,416	1,074	0	0
2	150	150	0	0	150	0	2,934	1,200	0	0
3	150	150	0	0	150	0	3,986	1,270	0	0
4	150	150	360	0	510	150	4,794	1,500	7,200	0
5	150	150	1,200	1,200	1,350	1,350	7,224	3,718	24,000	24,000
6	150	150	2,040	360	2,190	510	9,656	2,588	40,800	7,200
7	150	150	3,000	3,000	3,150	3,150	11,634	5,868	54,000	54,000
8	150	150	4,800	1,200	4,950	1,350	13,521	3,913	76,800	21,600
9	150	150	6,000	7,200	6,150	7,350	15,730	11,960	96,000	115,200
10	150	150	5,400	600	5,550	750	15,192	2,986	86,000	12,000
11	150	150	7,200	8,400	7,350	8,550	17,633	13,635	115,200	126,000
12	150	150	6,000	600	6,150	750	16,897	3,457	96,000	12,000
13	150	150	8,400	8,400	8,550	8,550	22,827	13,857	134,400	126,000
14	150	150	7,200	600	7,350	750	19,087	3,457	115,200	12,000
15	150	150	9,600	8,400	9,750	8,550	22,827	13,857	153,600	126,000

VI-2. Model Project of Afforestation and Reforestation.

VI-2-1. Introduction :

The Saddang River watershed area covers 4 Kabupaten-s such as Tana Toraja, Enrekang, Pinrang and Polmas. The area extends 630,000 ha. and among its area, bare lands and critical areas extend 238,570 ha. (38%).

It is said that bare lands in the entire Indonesia extend to 24,000,000 ha. and they may cause floods which deteriorate food productions in this country.

The Government realize that it should have been important to put a priority on the execution of afforestation and reforestation on the base of various motivations, e.g. :

- to make a success in the National Food Program;
- to reduce the hazards of flood and drought occuring every-where and each-year;
- to maintain and improve soil fertility;
- to improve living environment;
- to improve villagers' socio-economic conditions;
- to provide raw materials for industries and export sectors;
- to even incomes among regions;
- to overcome firewood shortage in the long run.

When a socio-economic value of a forest in a community as a whole is focused upon, it would be found that it has the following functions :

i). Water is retained in forest soils;
ii). Erosion does not occur with a forest nor much less than without it;
iii). It may prevent landslides;
iv). It provides good amenities with both human beings and wild animals; and
v). It provides fuel and building materials with local people.

Regarding this project, it is placing emphasis on the first point i.e. water retention of the forest soil in order to even the water flow of the river and further to control flood in the downstream

VI-2-2. Analysis :

In case of much rainfall, water discharge tends to be less in the forest land than in the grassland.

There is also theoretically ground for considering the function of forest as to peak-cut effect at the time of much rain more than water retention effect.

Now we focus on the forest function of flood control literally peak-cut effect.

Forest is considered that it plays a role like a regulating resovoir which retain water run off. The benefit of forest, in this connection, is the balance of the amount retained between grass land and forest as a resevoir.

This means the forest may make water discharge even during flood.

Therefore the benefit will be assumed by taking construction cost of a reservoir, which may conserve the equivalent amount of the water kept in the forest can be calculated as an opportunity cost (return period ; 50 years).

The differance of discharge in grassland and forest is calculated by the following rationalized formula.

$$V = (r_i - r_c/2)\ Ti.f.A\ \frac{1}{3.6}$$

Where, V = The difference of disharge in grassland and forest (m^3)

r_i = Rainfall intensity during Ti hours which maximize the capacity of reservoir.

r_c = Rainfall intensity equal to peak discharge in the lower stream, converting forest.

T_i = Time, which maximizes the capacity of reservoir (minutes)

f = Run off-ratio in the forest

A = Watershed area (Km^2).

Then, according to the report " Development Survey on Bakaru Hydroelectric Power Project In The Saddang River " 1977 September JICA, the maximum daily rainfall is 214 mm, and the flood concentration time is 10.2 hours

Generally, the Saddang watershed area is almost same as Bakaru observed from the topographical map.

The figure of the flood concentration time ;10.2 hours is also aplied. The rainfall intensity ; R at the time of flood is as follows;

$$R = \frac{214}{24} \times \left(\frac{24}{10.2}\right)^{\frac{2}{3}} = 15.8\ ^{mm}/hr.$$

$$r_c = \frac{f_w}{f_g} \times R = \frac{0.6}{0.8} \times 15.8 = 11.85$$

where, f_g = run-off ratio on grassland = 0.8

f_w = run-off ratio on forest = 0.6

Because r_i = is rainfall intensity during Ti

$$r_i = \frac{214}{24} \times \left(\frac{24}{Ti}\right)^{\frac{2}{3}} = 74.2\ Ti^{-\frac{2}{3}}$$

$$\text{Then}\quad V = (74.2\ Ti^{-\frac{2}{3}} - 11.85/2) \times Ti \times f \times A \times \frac{1}{3.6}$$

$$= (74.2\ Ti^{\frac{1}{3}} - 5.925\ Ti) \times f \times A \times \frac{1}{3.6}$$

Now, in order to maximize Ti, V is differentiated by Ti as follows :

$$\frac{dV}{d\,Ti} = (74.2 \times \frac{1}{3} \times Ti^{(\frac{1}{3}-1)} - 5.925) \times f \times A \times \frac{1}{3.6} = 0$$

$$\therefore Ti = 8.53$$

Therefore,

$$V = (74.2 \times 8.53^{-\frac{2}{3}} - 11.85/2) \times 8.53 \times 60$$
$$\times 0.8 \times 2.385.7 \times \frac{1}{3.6} = 3.215 \times 10^6$$

The construction cost of the dam which is 124.233×10^6 US \$ derived from the Bakaru Hydroelectric Power Project (gross capacity ; $8.38 \times 10\ m^3$, Durability period ; 50 years).

The annual cost including interest equivalent to the long-term loan rate in this country, i.e. 12% per annum, and depreciation can be calculated as follows :

$$\frac{124.233 \times 10^6 \times 625}{\sum_{n=1}^{50} \frac{1}{(1+0.12)^n}} = 9.349 \times 10^6 \text{ Rp/year.}$$

However, this figure may be reasonable or groundless because this dam is not for water retention but for hydroelectric generation.

If, 100%, 80%, 60%, 40% and 20%, of the cost is considered, the following table for each case is given,

Case	Case (1)	Case (2)	Case (3)	Case (4)	Case (5)
Unit cost of water ($Rp/m^3/year$)	1.157 (100%)	926 (80%)	694 (60%)	463 (60%)	231 (20%)
Benefit ($\times 10^9$ Rp/year)	3.72	2.98	2.23	1.49	0.74

Cost for afforestation ; M in this area per annum is found by the following formula;

$$M = S \times \frac{\text{interest}}{(1 + \text{interest})^{\text{felling period}} - 1}$$

where, M ; annual value

S ; last value

Accordingly, the data obtained from DAS experiences give the followings :

$$S = 220 \times 10^9 \text{ Rp}$$

Then, $$M = 220 \times 10^9 \times \frac{0.12}{1.12^{26}-1} = 1.46 \times 10^9 \text{ (Rp.)}$$

Therefore,

Case	Case (1)	Case (2)	Case (3)	Case (4)	Case (5)
B/C ratio	2.55	2.04	1.53	1.02	0.51

Conclusion :

Among 5 cases the result shows that B/C ratio exceeds one (1) from casa (1) to case (4).

Now, if the unit cost of water is 39% of the construction cost of the dam, the benefit becomes equal to the cost.

This figure shows the break-even point. In other word, if the construction cost of the reservoir is 39% of the costruction of the Bakaru Hydroelectric Power Dam, this afforestation project can be feasible.

VI-3. Model Project of Grassland Improvement.

VI-3-1. Introduction :

According to statistics, the number of animals has not increased and even their proportion to human population in whole Indonesia has significantly decreased due to population growth. Where an extension of marginal lands is not expected, the sites are badly overgrazed, so the stocking rate is to be pushed further down without any pasture improvement planned.

Looking at the population of livestock in Enrekang (1969 - 1977) in Table 1, it was found that there was an increasing tendency in the number of cattle equivalent, in which the numbers of buffalo, goat and horse were multiplied by the weights, respectively 1.3, 0.1 and 0.7 as follows :

$$\begin{bmatrix} \text{Cattle Buffalo Goat Horse} \\ \text{(Table 1)} \end{bmatrix} \times \begin{bmatrix} 1.0 \\ 1.3 \\ 0.1 \\ 0.7 \end{bmatrix} = \begin{bmatrix} \text{Cattle Equivalent} \end{bmatrix}$$

The cattle equivalent growth could be calculated in the following equation :

$$y = 24954 \times (1 + 0.0527)^t$$

$$(r = 0.942)$$

where, y = expected cattle equivalent

$t = 0$ is in 1969.

This formula shows that the annual grass production in this area increase at 5.57% if animals were fed same amount as before.

In Enrekang, a marginal land for grazing was so scarce that overgrazing may accrue year by year at an annual rate of 5.57%. Moreover, overgrazing has caused land deterioration like forest destruction and soil erosion.

This is the reason why the new forage resources should be procured by a means of the increase in productivity of the pasture.

VI-3-2. M o d e l s :

In this analysis, therefore, two grassland management models were set up, i.e. with and without grassland improvement and the comparison between them was made.

Model of Grassland Improvement Project

The model ranch management was designed with the same acreage of 50 ha. as that without grassland improvement, assuming that there is no land extended.

The 25 ha. of native grassland is improved with the forage crop introduction which will assure the productivity of 3 times as much as that of the native grass. As a consequence, 1300 ton of fresh grass is produced annually and 100 heads of cattle of the same herd composition as in the case without grassland improvement can be supported.

The 25 ha grassland is improved in 3 years. In order to organize the 100 heads of cattle herd from 50 heads of cattle herd, 2 heads per year of female calves must be supplied from the original herd for 5 years; in addition, 5 heads per year of female calves must be purchased for 4 years.

Cattle population transition and income by cattle sale are shown in Tables 3 and 4.

With the annual reproductive rate of 60% the cattle population will be over 100 heads in 5 years, but the benefit derived from the sale of surplus cattle is limited during the cattle population increase.

After the establishment of the new type management, annual income obtained from the surplus cattle is supposed to be Rp.3,900,000,- i.e. twice as much as that without grassland improvement. However, additional cost must be required for the grassland maintenance and fertilizer application.

Other costs such as cattle replacement, supplementary feed, animal sanitation and other supplied also increase twice as much as that without grassland improvement (cf. Table 2.).

The regular labor in the model ranch is assumed to be three men.

During the first 4 years a large amount of investment cost is required, as shown in Table 5.

Model Without Grassland Improvement

The model ranch management was designed with 50 ha. of native grassland and 50 heads of cattle herd as shown in Table 2. The model composition of cattle herd is described in Chart 1. Under the assumption of the 60% reproductive rate, 24% of surplus cattle for sale can be produced annually.

Annual income obtained from the surplus cattle is supposed to be Rp.1,950,000,- as shown in Table 4. The unit price is referred to in the Annual Report of Kabupaten Enrekang Animal Husbandry Service (1979/1980).

The productivity of native grassland is assumed to be 13 ton/ha./year, without any fertilizer application. Annual production of fresh grass is 13 ton/ha. x 50 ha. = 650 ton. If the amount of intake by cattle is 13% of the body weight, 650 ton of fresh grass is enough to support 50 heads of the model herd.

No investment is made on grassland improvement, maintenance nor fertilizer application.

Such expenditures as cattle replacement, supplementary feed, animal sanitation and other supplies are inevitable in order to support cattle management.

The regular labor in the model ranch is assumed to be two men.

VI-3-3. Financial Analysis

The improved technology was examined from the standpoint of financial feasibility of the presumed ranch management of 50 ha. For the calculation of B/C ratio, the annuity factor of 12% was used and the models were assumed ti last 20 years.

Table 6 shows that the B/C ratio with the grassland improvement technology is 1.033, while that without grassland improvement is 2.308

It is resulted from the fact that in the case of without grassland improvement no cost on forage production is required.

On the other hand, however, in the case of grassland improvement, a large amount of investment cost, as well as operational and maintenance costs will be required for forage production.

Moreover, production cost, which is tightly connected with cattle population, becomes twice as much as the cattle population is growing.

As a consequence, even after a new ranch mechanism is established, the annual benefit remains twice as much, while the annual cost becomes 2.4 times as much.

The investment cost required in the early stage serves to lower the Net Incremental Value.

As a means of sensitivities' allowance, the sensitivity analysis was carried out in Table 6. The future prices of cattle cannot be projected so that the financial analysis was made at the present price, for instance Rp.200,000,- for adult male and Rp.180,000,- for adult female in Table 4. In the sensitivity analysis, these prices were assumed to 10% and 20% up because there is an increasing trend in the market.

The proposed grassland improvement is based upon the assumption that the maintenance management of grassland is successfully conducted so that improved grassland can constantly produce the required amount of forage during the given term. But as general tendencies, the forage production has to suffer some fluctuation and constant deterioration.

VI-3-4. Social Evaluation :

(1) Increase in Productivity and Income

As a result of grassland improvement the forage production will be doubled to assure the support of twice as much as the existing cattle population.

The annual benefit will also be doubled from Rp.1,950,000,- to Rp.3,900,000,-. This means that the double of products are derived from the limited acreage of lands.

The net income increases from Rp.845,000,- to Rp.1,279,000,- at 51%.

(2) Increases in Employment

The regular animal husbandsmen will be increased from 2 persons to 3 persons as the result of a greater labor requirement accompanied by grassland management and animal population increase.

1,370 man days of additional labor are required for the grassland improvement for the 3 years, thus the employment opportunity will increase significantly.

(3) Promotion of Regional Livestock Production and Land Conservation

As this kind of project expands to other regions, regional production of livestock will increase, thus it will supply more animal meat to the inhabitants.

The idea of grassland improvement is based upon the productivity increase in the limited lands, so that development should be organized in harmony with other regional sectors like afforestation and reforestation.

(4) Necessity for Governmental Aid

As stated above, it seems very difficult to draw benefits by means of grassland improvement. It is also difficult for individual farms to try grassland improvement because it requires a large amount of investment cost in the early stage of the project. However, in view of the increase in demand for meat and land conservation, some countermeasures must be taken on the forage production. The virgin native grassland must be set free for livestock production if there are any, otherwise, some governmental aids are required for the grassland improvement project.

Chart 1. MODEL OF CATTLE HERD COMPOSITION

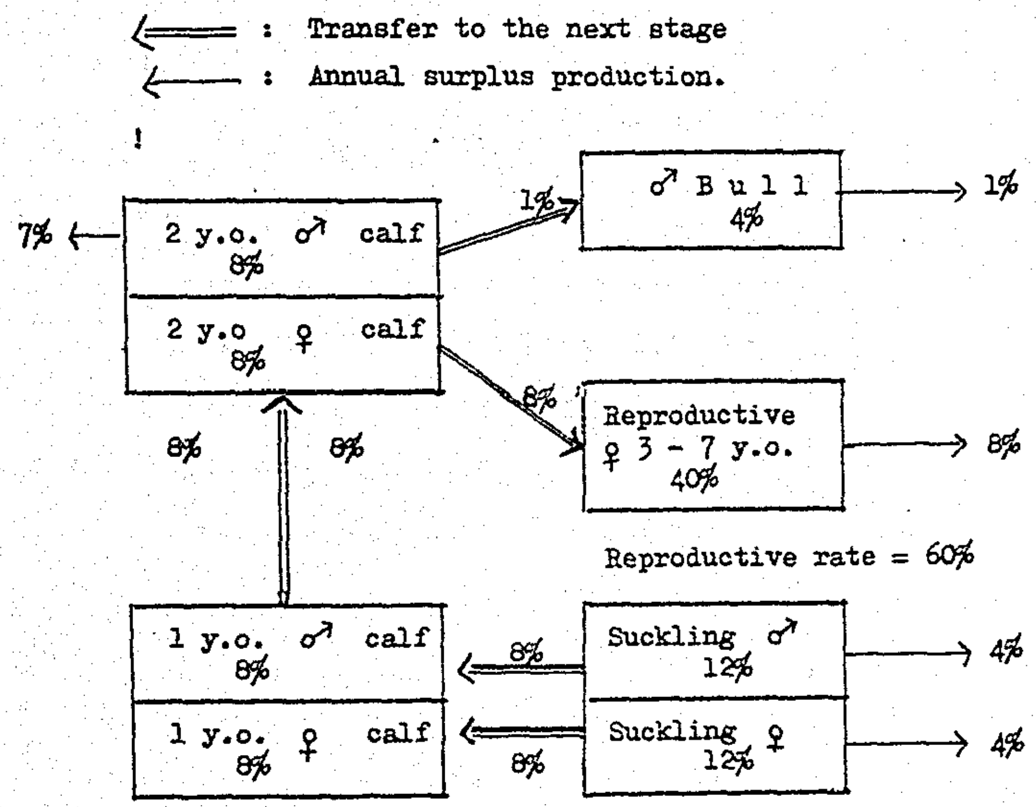


Table 1. POPULATION OF LIVESTOCK AND CATTLE EQUIVALENT IN KABUPATEN ENREKANG (1969 - 1977).

Unit : heads

YEAR	BEEF CATTLE (X 1.0)	BUFFALO (X 1.3)	G O A T (X 0.1)	HORSE (X 0.7)	T O T A L CATTLE EQUIVALENT : (weights)
1969	17,831	3,441	11,388	2,585	25,252,6
1970	19,530	3,423	6,835	2,005	26,066,9
1971	21,570	3,733	7,474	2,175	28,692,8
1972	14,095	7,522	11,077	3,897	27,709,2
1973	16,243	9,131	15,286	4,797	32,999,8
1974	14,789	7,642	15,298	5,083	29,811,5
1975	16,076	8,457	13,719	5,459	32,762,7
1976	17,094	9,248	23,121	5,859	35,559,8
1977	18,851	10,706	25,354	6,285	39,703,7

Source : ANIMAL HUSBANDRY OFFICE OF SOUTH SULAWESI PROVINCE.

Table 2. GRASSLAND MODEL WITH 50 ha,

I T E M :	WITH :	WITHOUT :
Native Grassland	25 ha.	50 ha.
Improved Grassland	25 ha.	N o n e
Number of Cattle	100 heads	50 heads
Production of Cattle	24 heads/year	12 heads/year
Grassland Maintenance	Rp.216,000,-/year	N o n e
F e r t i l i z e r	Rp.560,000,-/year	N o n e
Cattle Replacement	Rp.200,000,-/year (for 100 heads)	Rp.100,000,-/year (for 50 heads)
L a b o r	Rp.1,095,000,-/year (3 x 365 manpower)	Rp.730,000,-/year (2 x 365 manpower)
Supplementary Feed	Rp.250,000,-/year (Rp.2,500,-/head)	Rp.125,000,-/year (Rp.2,500,-/head)
Animal sanitation	Rp.100,000,-/year Rp.1,000,-/head)	Rp.50,000,-/year (Rp.1,000,-/head)
Other Supplies	Rp.200,000,-/year (Rp.2,000,-/head)	Rp.100,000,-/year (Rp.2,000,-/head)

Table 3. MODEL OF CATTLE POPULATION TRANSITION

Unit : heads

Year' / Cattle	Without Grassland Improvement	With Grassland Improvement					
		0 year	1	2	3	4	5
1 y.o. ♀ calf	4	11	11	11	13	10	8
2 y.o. ♀ calf	4	4	11	11	11	13	8
Reproductive ♀	20	20	20	27	34	41	40
Suckling ♀	66	6	6	8	10	12	12
Suckling ♂	6	6	6	8	10	12	12
1 y.o. ♂ calf	4	4	4	4	6	8	8
2 y.o. ♂ calf	4	4	4	4	4	6	8
♂ . Bull	2	2.5	3	3.5	4	4	4
T o t a l	50	57.5	65	76.5	92	106	100

Table 4. MODEL OF INCOME BY CATTLE SALE

Cattle	Unit Price Rp.	Without grassland Improve.	With Grassland Improvement			
			0-2 yr.	3	4	5
(for sale)		(head)				
Adult ♀	180,000	4	4	4	5	8
Adult ♂	220,000	0.5	0.5	0.5	0.5	1
3 y.o. ♂	200,000	3.5	3	3.5	3.5	7
1 y.o. ♂	125,000	2	2	2	2	4
1 y.o. ♀	85,000	2	-	-	2	4
2 y.o. ♀	120,000	-	-	-	5	-
(for purchase)						
2 y.o. ♂	150,000	-	-	-	2	-
Total Income		Rp. 1,950,000,-	Rp. 1,680,000	Rp. 1,780,000	Rp. 2,430,000	Rp. 3,900,000

Table 5. FINANCIAL ANALYSIS ON "WITH" AND "WITHOUT"

(Unit : x Rp.1,000,-)

Year	Investment cost	O & M Cost	Production Cost	Cost	Benefit	Incremental	
						Cost	Benefit
0	1,425 a) 100 b)	224 0	1,418 1,005	3,067 1,105	1,680 1,950	1,962	- 270
1	1,339 100	448 0	1,463 1,005	3,250 1,105	1,680 1,950	2,145	- 270
2	985 100	560 0	1,525 1,005	3,070 1,105	1,680 1,950	1,965	- 270
3	584 100	776 0	1,597 1,005	2,957 1,105	1,780 1,950	1,852	- 170
4	212 100	776 0	1,666 1,005	2,654 1,105	2,430 1,950	1,549	480
5	200 100	776 0	1,645 1,005	2,621 1,105	3,900 1,950	1,516	1,950
6 to 19							
20	200 100	776 0	1,645 1,005	2,621 1,105	3,900 1,950	1,516	1,950

Note : a). With Grassland Improvement

b). Without Grassland Improvement

Table 6. B/C RATIOS, NET INCREMENTAL VALUE AND SENSITIVITY ANALYSIS.

Cases	B/C Ratio	Net incremental v.	Sensitivity Analysis	
			10% up	20% up
With Grassland Improvement.	1.033	Rp.791,642,-	1.136	1.240
Without Grassland Improvement	2.308	Rp. 9,358,429,-	2.539	2.770
Increment (With - Without)	- 1.275	- Rp. 8,566,787,-	-1.403	-1.530

VI-4. Combined Model Project of Forestry and Mini-Ranch.

It is urgently needed to establish forests where at the present deterioration of the mountains is going on due to deforestation and sequent overgrazing.

Afforestation in such areas has two main purposes ; first it should prevent land from deterioration and secondly it provides fuel and building materials with local people.

The figure shows two ways to prevent land from degradation, i.e ; afforestation / reforestation and grassland improvement.
However, the former method has been taken by the Governmental assistance (DAS), but the latter method has been taken by private chanels.

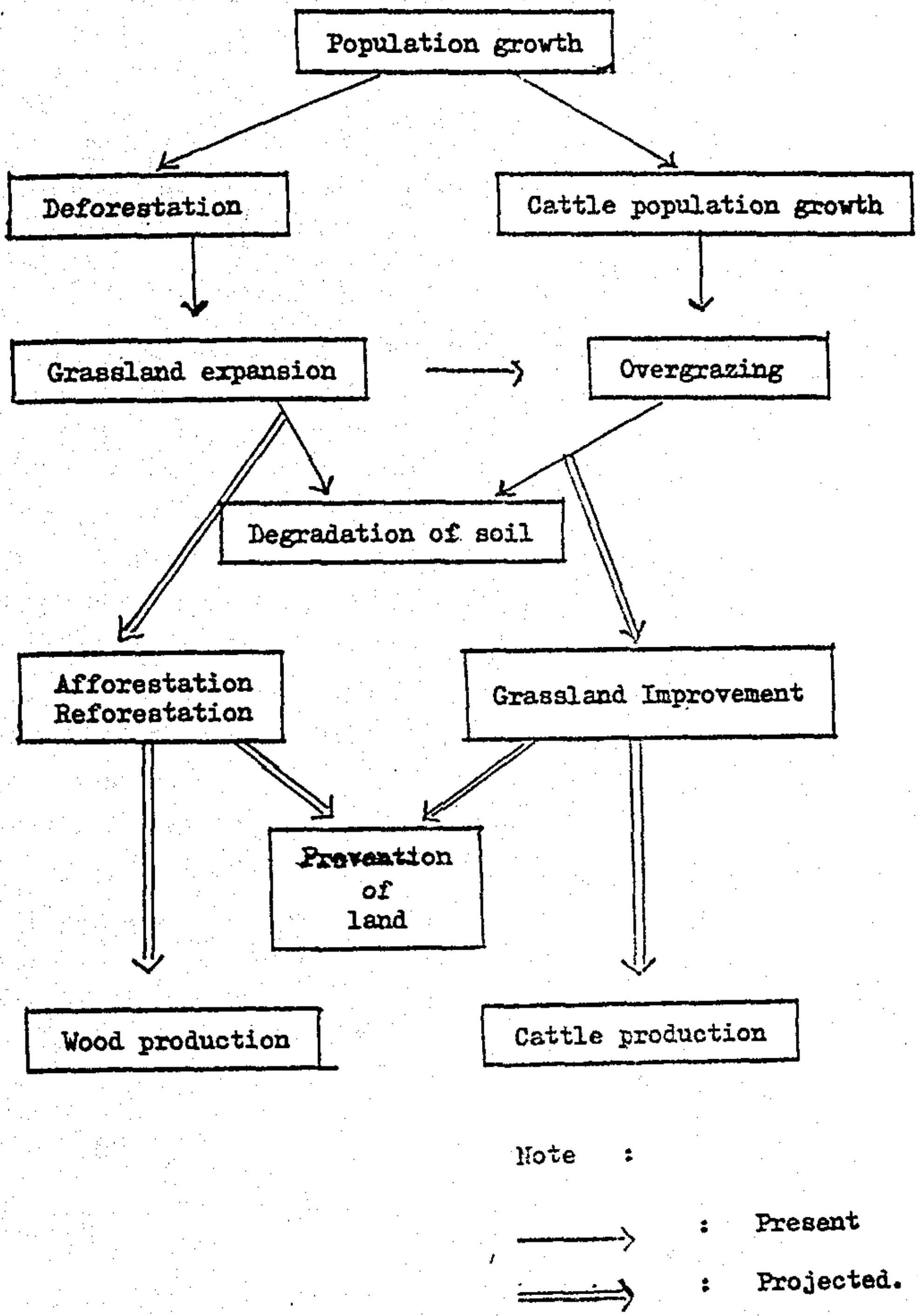
In the past experience, it came to be judged that grassland improvement has no advantage with a heavy burden of investment in financial terms. This is because a very few cost taken for natural grazing with grassland development.

In this analysis, a model with 100 ha is set up and is involved in afforestation and grassland improvement in order to harmonize communal forest with mini-ranch.

VI-4-1. Model :

From the viewpoint of a society as a whole, the model is examined by the linear programming method.

In the model, a natural grazing land with 100 ha. is devided into


Population growth
Deforestation
Cattle population growth
Grassland expansion
Overgrazing
Degradation of soil
Afforestation
Reforestation
Grassland Improvement
Prevention
of
land
Wood production
Cattle production
Note :
: Present
: Projected.

two parts; communal forest with X_f ha. and mini-ranch with X_g ha. Therefore, $(X_f + X_g)$ ha. do not exeed 100 ha. as the following inequal equation.

$$X_f + X_g \leqq 100 \qquad \text{------------} \qquad (1)$$

For the local people who had 100 ha. for grazing, the benefit drawn from improved grassland is expected to exceed the benefit from natural grassland of 100 ha.

$$b\,X_g \geqq B \times 100 \qquad \text{------------} \qquad (2)$$

Where, b : per ha. & yearly benefit from grassland with project.
B : per ha. & yearly benefit from grassland without project.

The benefit from the forest is considered to be shared by the economy as a whole.*. This is the reason why the public funds go to the forestry sector for afforestation and reforestation. However, the benefit from the animal production is considered to be shared by the private sector.

Therefore, the large amount of investment cost for grassland improvement is prepared by the beneficiaries themselves. If, however, the both sectors are considered as mutural dependence, the analysis should be carried out from the viewpoint of an economy as a whole. Hence, all the benefit from the project should be shared by the both sectors, then the benefit from forest should be equal to or exceed the costs of afforestation and grassland improvement as follows,

* Forest is considered to have several public effects (Social functions) like flood control, provision of good amenities, retention of water, etc.

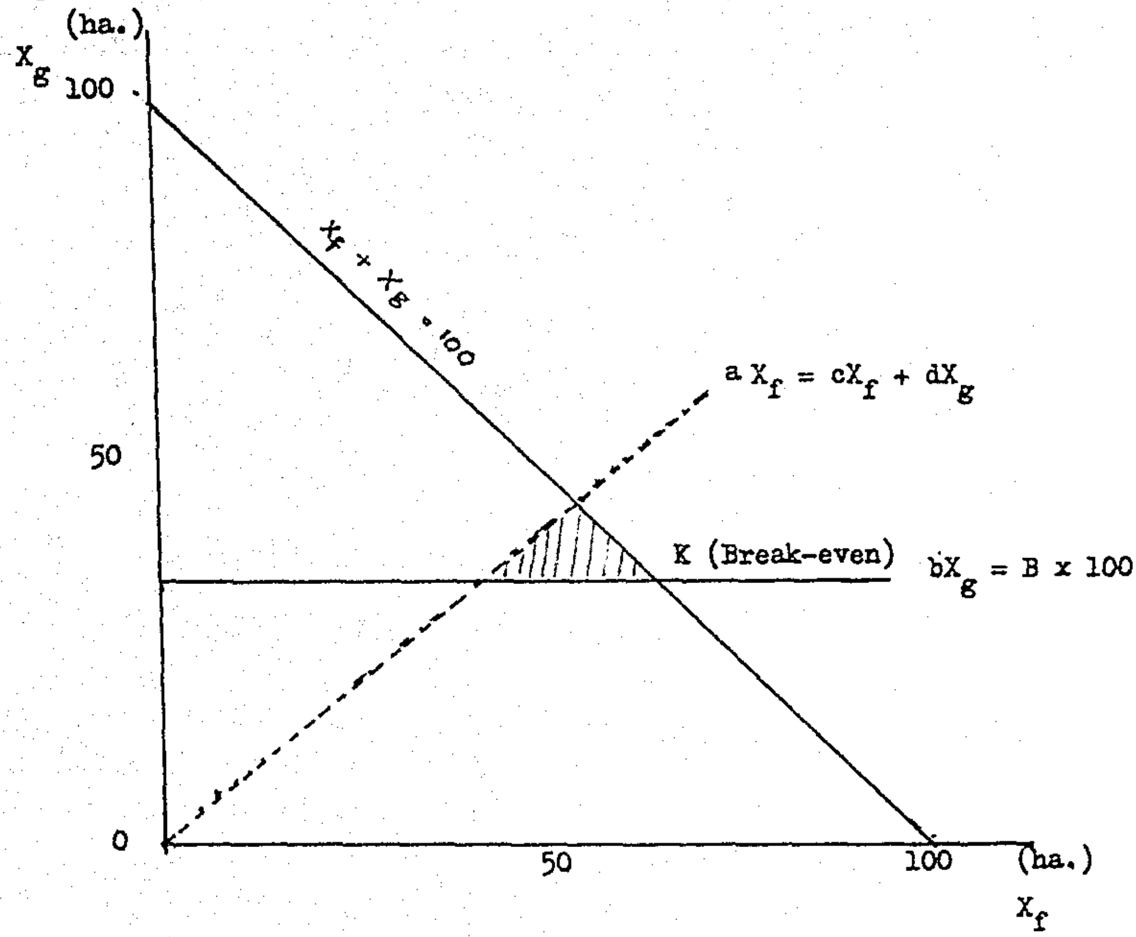
$$a\,X_f \geqq c\,X_f + d\,X_g \qquad \text{------------} \qquad (3)$$

Where, a : per ha. & yearly benefit from forest.
c : per ha. & yearly cost for afforestation.
d : per ha. & yearly cost for grassland improvement.

Consequently the following equation should be maximized.

$$a\,X_f + b\,X_g = \text{max.} \qquad \text{------------} \qquad (4)$$

The three inequal equations (1), (2) and (3) are shown in the following figure.



In the figure, the shadowed area is the possible area where the point of intersection of two lines ; k is break-even *.

	Forest	Grassland
(B) Incremental Benefit	$a\ X_f$	$b\ X_g - 100$
(C) Incremental Cost	$c\ X_f$	$d\ X_g$

$$\text{B/C ratio} = \frac{(B)}{(C)} = \frac{a\ X_f + b\ X_g - 100\ B}{c\ X_f + d\ X_g},$$

But, at the point k, $b\ X_g - 100\ B = 0$ from the equation (2).

$$\frac{(B)}{(C)} = \frac{a\ X}{c\ X_f + d\ X_g}$$

Then, from the equation (3)

$$\frac{(B)}{(C)} = 1.$$

* The break-even point implies that B/C ratio is 1.
Accordingly, at that point, the cost is equal to the benefit.
Namely, the following calculation shows it.
The cost benefit occured shows in the following table.

The following benefits and costs were calculated in the later pages.

$a'_* = 122,766$

$b = 117,000$ $\qquad B = 39,000$

$c = 73,700$

$d = 160,600$

(* a is the benefit of forest excluding it of social functions).

At the point k where B/C ratio is one, the benefit of forest ; a is :

$$a = \frac{dB}{b-B} + C$$

Therefore,

$$a \geqq \frac{dB}{b-B} + C = 154,000.$$

If the benefit; a exceeds Rp.154,000,-/ha., the project is economically feasible. The benefit including log production but excluding social functions; a', however, counts Rp.122,766,-/ha.

If the benefit of forest includes social functions, whose numerable benefit may exceed Rp.31,234,-/ha. (= 154,000 - 122,766), the project should be economically feasible.

VI-4-2. Discussion and Conclusion :

In the former chapter where the social benefit of forest was discussed; the forest has benefit focusing upon flood control, litrally peak-cut effect.

In this connection, a forest is so beneficial in terms of society as a whole as well as local economy that the numerable benefit should largely exceed Rp.154,000,-/ha./year.

Hence, it is the point K where the total benefit; $a X_f + b X_g$ is maximized.

Then, 100 ha. of land is divided into

$X_f = 66.7$ ha., and

$X_g = 33.3$ ha.

This division is entirely dependent upon the carrying capacity of an improved grassland. In the reality, the public funds of DAS entirely support the planting of nurseries for afforestation/ reforestation so thet the cost; $c X_f$ is zero. Then, B/C ratio for local people is

$$\frac{(B)}{(C)} = \frac{a'X_f}{d X_g}$$

Therefore, if (B) $\geqq$ (C). the cost of grassland improvement occured to local people should be supported upto $d\ X_g - a'X_f$, by the public sector, which means that the cost of improvement deducts the real benefit of forest.

VI-4-3. Calculation :

(1). Benefit of forest :

As mentioned before, forest provides benefits with society as a whole. Countable (numerable) benefit of it is production of fuel and building woods for local people. Now, the calculation of this benefit is as follows,

Model :

Pinus merkusii trees are planted with spacing 2 x 3 m. and it takes 1 year for nursery to be planted and the *felling* term is 15 years. During the time, the thinned logs and branches can be used for fuel of village dwellers.

The yield of Pinus merkusii is shown in the following table, according to Vademecum Kehutanan Indonesia.

(Bonita III) *

Year	Number of trees	Average height	Diameter	Volume	Thinned volume
5	1,170	4.9 m.	6.6 m.	20 m^3/ha.	6 m^3/ha.
10	605	12.0	19.8	74	31
15	410	18.5	26.6	147	41

Note : * Surveyed by Mr. Tando.O.

The producer's price of logs is presumed to be Rp.20,000,- per m^3 and the discount rate is 0.12.

Then, benefit of logs per annum = Rp.20,000,- x 147 m^3 x

$$\left(\frac{0.12}{1.12^{16}-1}\right) = \text{Rp.68,766,-/ha.} \text{ ——— (1)}$$

Merkusii produces 78 m^3/ha thinned logs for 15 years and this means 4.5 m^3/ha. per annum. They might be entirely used for fuel instead of kerosene, whose calorific value is assumed 5 times of a wood interms of volume.

Kerosone costs Rp.60,-/ l at the present.

Therefore, benefit of thinned logs per annum

$$= \text{Rp.60,-/ l} \times 1/5 \times 4.5\ m^3$$
$$= \text{Rp.54,000,-/ha.} \text{ ——— (2)}$$

Hence, the total numerable value of the benefit per annum is,
a' = (1) + (2) = 122,766 Rp./ha.

(2) Benefit of grassland :

The one-hectar grassland with project is assumed to be able to sustain 3 cattles on the average.
The model income from cattle sale with project : 50 ha. is as follows :

// adult ♀	@ Rp.	180,000,-	x	12	heads.
adult ♂	@ Rp.	220,000,-	x	1.5	heads.
3 yr. ♂	@ Rp.	200,000,-	x	10.5	heads.
1 yr. ♂	@ Rp.	125,000,-	x	6	heads.
1 yr. ♀	@ Rp.	85,000,-	x	6	heads.
Total	= Rp.5.850,000,-				

There per hectar benefit without project is

b = Rp.5,850,000,- ÷ 50 ha. = Rp.117,000,-/ha.

The benefit without project is 1/3 of it

P = Rp.117,000,- ÷ 3 = Rp. 39,000,-/ha.

(3) . Cost of forest :

The cost of a piece of nursery in Rp. 15,-.

The planting dimension is 2 x 3 m. so 1.650 nurseries are needed for a single hectar.

Therefore, the cost of nurseries per ha., is :

Rp. 15,- x 1.650 x 1.2 = Rp. 29,700,- where, 20% of risk is taken.

On the other hand, the cost of planting is Rp.44,000,-/ha.

Then, the total cost is c = Rp.73,300,-.

(4). Cost of grassland :

This cost is devided into land improvement cost, cattle-purchasement cost, fertilizers and sanitation on the basis of with-without principal.

1). Land improvement cost :

labor	; 56 man day/ha. x 1,000 Rp./man day	= Rp. 56,000,-/ha.
nursery	; 1,000 kg./ha. x 10 Rp./ha.	= Rp. 10,000,-/ha.
pile for fence	; 224 m./ha. x 3 x 1.2 x 200 Rp./pile x 1/2 x 1/5	= Rp. 16,128,-/ha.
barbed wire	; 224 m./5 ha. x 3 x 1.2 x 4 lines x 10 Rp./m. x 1/5	= Rp. 6,451,-/ha.
T o t a l	;	= Rp. 88,579,-/ha.

Annual cost with 20 year depreciation.

$$\text{Rp. } 88{,}579{,}\text{-} \div \sum_{n=1}^{20} \frac{1}{(1+0.12)^n} = \text{Rp.}11{,}860{,}\text{-/ha. year.}$$

2). Cattle purchasement :

@ Rp. 80,000,- every year with 4 year depreciation.

Therefore, annual cost $= \text{Rp.}80{,}000{,}\text{-} - \sum_{n=1}^{4} \frac{1}{(1+0.12)^n} =$

Rp.26,342,-/ha. year.

3). Fertilizers :

Urea	250 kg./ha. x Rp.70,-/kg.	= Rp. 17,500,-/ha.
TSP	70 kg./ha. x Rp.70,-/kg.	= Rp. 4,900,-/ha.
T o t a l		= Rp. 22,400,-/ha.

4). Sanitation : Rp.100,000,-/ha.

Therefore, d = 1) + 2) + 3) + 4) = Rp. 160,600,-/ha.

CHAPTER VII. SUMMARY OF THE MASTER PLAN OF BLOCK III AREA

Azis Matola
Dahlan Noor
Andi Makkasau
Yusuf Marzuku

Contents

CHAPTER VII SUMMARY OF THE MASTER PLAN OF BLOCK-III AREA

The Master Plan of Block-III area was completed by the study team of Block-III and was published in October 1981 as a report named " Laporan Studi Perencanaan Pengembangan Pertanian Block III (Kabupaten : Bone, Soppeng dan Wajo)" written in Indonesian language.

For the sake of reader's reference, we have translated the part of " Conclusion and Recommendations " of the above-mentioned Master Plan and have cited in the following pages. As for the datails the readers are kindly requested to refer the original report (Laporan).

VII-1 Conclusion

(1) The area of Block III extends 852,553 ha. which constitutes 13.55% of the entire South Sulawesian area.

(2) Population growth rate from 1974 to 1978 was 1.5% per annum.

(3) Population density in 1978 was as follows: geographic density : 143 men per km^2 and agrarian density : 0.33 ha. per man.

(4) Labor force numbers 709,925, comprising 321,560 male (45.29%) and 388,365 female (54.71%), while labor employment numbers 556,913, comprising 241,167 male (43.30%) and 315,746 female (56.70%).

(5) Population distribution shows a great part dwelling in the rurals, i.e. 84.15%, while 15.85% dwells in the urbans.

(6) Land use: the highest amount is forests - 33.54% (285,935 ha.), successively followed by upland farms (homeyards) - 20.98% (178,861 ha.), paddy fields - 22.43% (174,135 ha.), other lands - 8.63% (73,556 ha.), pastures - 5.89% (50,120 ha.) and arable dry lands - 4.18% (39,816 ha.).

(7) Farm lands relate to the entire extent of Block III as 47.96%, comprising those in Kabupaten Wajo (50.39%), Kabupaten Bone (49.98%) and Kabupaten Soppeng (37.81%).

(8) Farm land utilization during 1 year's period is as follows: dry season paddy on wetlands; 90% ; food crops: 68.07% and estate crops: 11.34% on dry lands.

(9) Relation between the extent of irrigated paddy fields and that of non-irrigated ones is 17.68% (39,970.55 ha.) to 82.32% (144,202.34 ha.).

(10) Water resources development for irrigation is highly feasible in view of the great number of usable rivers, i.e. 17 in Kabupaten Bone, 14 in Kabupaten Soppeng and 4 in Kabupaten Wajo.

(11) Most of the mountain slopes which used to be grown by primary forests have practically been turned into upland farms for shifting cultivation, so that bare lands extend to about 53,227 ha. This situation certainly hinders water availability and may also generate erosion and flood.

(12) Means of communication is lacking both in road distribution and in quality. Data available showed an extent of only 360,085 km. paved roads in 1978 or about 10% of the existing roads.

(13) Land holding in Block III today ranges around 1.74 ha. consisting of 1.11 ha. wetlands (paddy fields) and 0.63 ha. dry lands or a ratio of 64:36. This ratio varies among Kabupaten-s and Kecamatan-s. Status of land-holding is as follows: owner-tilled 60%; tenant-tilled 34% and product-sharing basis laborer tilled 6%.

(14) Supporting means for agricultural development has not functioned properly. Fertilizers and drugs have not yet been used uniformly in the 3 kabupaten-s. Kabupaten Bone is the least to use fertilizers and drugs as compared with the other two.

(15) Marketing of farm products constitutes the main obstructing factor in farmer income improvement. Besides the difficulty in raising their income, their manner of income utilization is irrational e.g. only 2.34% for education while 13.24% and 4.23% were recorded for respectively luxury and social donation.

(16) Labor force and labor employment relate to the population as 57.75% for labor force and 45.31% for labor employment, according to population census of 1980.

(17) Wet season paddy and upland paddy in Block III show quite a good development both in areal extent and in production, in spite of the low rate of productivity, while dry season paddy (gadu) shows a substantial decline both in areal extent and in production, at quite a fair rate of productivity.

(18) Maize, cassava, sweet potato, ground nut and beans show quite a good development both in areal extent and in production but a low productivity.

(19) In 1978 this region showed a surplus of resp. 43,[illegible] tons rice 6,885 tons maize and 2,117 tons ground nut while lacking resp. 41,983 tons cassava and 4,[illegible] tons beans.

(20) Block III indicates a good trend in the development of estate crops such as coconut, clove, kapok, sugar cane and tabacco, in spite of the extremely low rate of productivity.
Pepper, coffee and candlenut show less good development.

(21) Livestock population seems to have quite a good development, yet still in shortage to meet the need of the region. Pasture area is extremely short as related to the livestock population growth.

(22) Fishery production such as from lakes, swamp, brackish water fish ponds, rivers and seas present a good picture.

(23) Afforestation is very little performed, as related to the extent of bare and critical lands.

VII-2 Recommendations

(1) In view of the population growth rate which is still below the national rate, it is to be maintained. It is left to be studied whether the low rate is due to the people's conscience of family planning or to the large amount of population outflow.

(2) A way should be found to open a field of employment, in view of the large number of labor force and labor employment.

(3) As population is distributed more in the rurals, it calls for consideration to utilize the existing labor force.

(4) The large extent of non-irrigated paddy fields in relation to the irrigated ones calls for serious consideration as to the development of irrigation, moreover in view of the large number of rivers feasible of being developed.

(5) Means of communication ought to be improved both in quality and in distribution, particularly the ways joining production centers with marketing places.

(6) The decreasing extent of farm lands necessitates the endeavor to make the most efficient use of each foot of it, applying the exact technology for the improvement of farmers' income.

(7) In addition to the efforts to lead farmers toward the increase of production and income, guidance should also be given to the best use of their income, in order to gradually raise capital to be invested in their farms.

(8) Production device should be improved in order to raise the productivity.

(9) A serious consideration is required for the development of dry season paddy in gaining a greater production as a food barn for the region.

(10) A serious consideration should be given in handling the present rice surplus, to maintain a steady market price.

(11) Production device for estate crops calls for attention in order to gain a fair productivity rate.

(12) Fishery development, e.g. in lakes, brackish water fish ponds, swamps and seas, calls for attention.

(13) Afforestation should be enhanced in the watershed areas of Walanae and Bila Rivers in order to prevent worse erosion damages in the future.

(14) Animal Husbandry should be managed better from the viewpoint of both feed supply and production increase.

CHAPTER VIII. FARMERS' TRAINING

Tadjuddin Dullah

Contents

CHAPTER VIII. FARMERS' TRAINING

VIII-1 Background

The study made by the RADP/ATA-140 South Sulawesi Project during 30 months consisting of two phases, such as mentioned in the preceding chapters, has decided the necessity of pilot test establishment, which constitutes the implementation of the results of study in planning, compiled together by the Experts' Team and counterparts.

Each of the pilot tests serves not merely as places for research and seed supply center, but also as a place of practical observation for farmers and the community. By this means the farmers are expected to take part in agricultural development by joining periodic trainings at the pilot tests.

VIII-2 Performance of the Training

The training for farmers/ key farmers, opened at the two Training Centers under each of the ATA-140 Pilot Tests is carried out on the base of :

(1) The Guide Book for Operational Activities of the ATA-140 Experts' Team.

(2) The mutual concensus between the Secretary of the Agricultural Employees' Education & Training Center (BPLPP) and the Deptan's Bureau of Planning concerning the performance of training for farmers /key farmers on Citrus and forages at the ATA-140 Training Center.

(3) The Decree by the Manager of the Agricultural Training Project at Batangkaluku, no. 27/ Kpts/ II/ 1982, dated February 10, 1982.

VIII-2-1 Objectives of the Training :

On completion of the training, the farmers/ key farmers are expected to be able of the following :

(1) Terracing on sloping lands, with efforts of afforestation/reforestation according to technical guidance and using the recommended plant species.

(2) To be agents of information, aiming at efforts by farmers in particular and the community in general towards forest, soil and water conservation in the context of preserving natural resources and living environment.

(3) Expanding forage planting areas and management of pastures, aiming at the increase of dairy products and soil conservation on critical areas.

(4) Establishing a combined pattern in the cultivation of industrial crops and horticulture, and skillful in preparing soil for nursery, planting and cultivation, including pest / disease control, harvesting and marketing.

(5) Managing Citrus cultivation in accordance with local trials and based on latest technical guidance recommended.

(6) Identifying symptoms of Citrus disease /pest invasion, and taking its countermeasures.

VIII-2-2 Place, time and organizing team.

(1) The training took place at the ATA-140 Pilot Test sites respectively at Desa Buntu Barana of Kabupaten Enrekang and at Desa Tino of Kabupaten Jeneponto, and at the Agricultural Training Station in Batangkaluku of Kabupaten Gowa.

(2) The training was performed from February 21 through March 19, 1982, thus lasting approximately 30 days.

(3) The training was performed by an Organizing Team, which was appointed by the decree no. 27 Kpts / II / 1982 by the Director of the Batangkalulu Training Station, dated February 10, 1982.
Administrator of the training : Mono Syamsuddin, ATA-140 Project Manager.
Field executive : Tadjuddin Dullah, ATA-140 Project Secretary, with 5 assistant executives.
Study commission : The Kanwil Deptan Chief as chairman; members consist of 3 people from the BLPP and several from the Food Crop Agricultural Service, Animal Husbandry Service, Forestry Training Center, totalling 8 people altogether.

VIII-2-3 Curriculum and Instructor Staff.

(1) Curriculum:

1) Basic subject group :

Farmers' role and function in Agricultural Development		5 periods.
Policy of the program on afforestation/ reforestation		5 "
Program on horticulture development		5 "
Socio-economic significance and function of livestock		5 "
	Total	20 periods.

2) Essential subject group :

Improvement of forage quality and production	15	periods
Pasture maintenance and seed production	15	"
Techniques of afforestation & reforestation	15	"
Soil and water conservation	22	"
Coffee & clove planting techniques	15	"
Various farming on arid lands	14	"
Farm management and analysis	8	"
Method for Citrus propagation	15	"
Good method of Citrus cultivation	15	"
Pest / disease control	15	"
Techniques of fruit planting & marketing	8	"
Total	150	periods

3) Supportive subject group :

Farmer organization KUD	6	periods
Family nutrition improvement / Civics	4	"
Lectures	18	"
Discussions	5	"
Field trips	17	"
Total	50	periods

(2) The main instructor staff in the context of technological transfer from the Japanese experts were counterparts in each of the pilot tests, specified as follows :

Afforestation / Reforestation (count.)		2	people
Grassland Improvement	"	2	"
Citrus Development	"	1	"
Food Crop Agricultural Service		5	"
Kanwil Deptan		5	"
Forestry Service		2	"
Project for DAS Saddang		1	"
Batangkalulu Training Station		4	"
Estate Crop Service		2	"
ATA-140 Project		2	"
Total		26	people.

VIII-2-4 Participants of the training.

Trainees originate from the two Kabupaten-s, respectively 30 people from each.

(1). Qualifications for trainees :

1) Male, 20 - 50 years old;
2) Possessing more than one farm;
3) Literate;
4) Physically and mentally healthy;
5) Able to join training during 30 days preseverantly.

(2) Educational background :

1)	Elementary School	4 people
2)	Junior High School	19 "
3)	Senior High School	7 "
	Total	30 people.

(3) Extent of farm possessed: :

1)	0.1 - 0.5 ha.	7 people
2)	0.6 - 1.00 ha.	3 "
3)	1.00 - 2.00 ha.	15 "
4)	More than 2.00 ha.	5 "

(4) Trainees' place of origin.

1) Kabupaten Enrekang :

Kecamatan Enrekang	2 people
" Maiwa	2 "
" Anggeraja	3 "
" Baraka	4 "
" Alla	5 "
Total	16 people

2) Kabupaten Jeneponto :

Kecamatan Kelara	7 people
Kecamatan Batang	7 "
Total	14 people
Totalling altogether	30 people.

(5) Age level :

20 - 25 years old	9 people
26 - 30 " "	11 "
31 - 40 " "	8 "
Over 40 " "	2 "

VIII-2-5 F i n a n c i n g.

Costs for the performance of this farmer training stem from the Project Sheet of the Batangkaluku Training Station / Project for Agricultural Training, Fiscal Year 1981/1982, specified as follows :

(1)	Provision of means and device for the training (dormitory & classroom equipment)	Rp	7,200,000
(2)	Training performance	Rp	7,430,000
(3)	Instructors' & officials' fee, travel costs, vehicle operational costs, etc.	Rp	5,370,000
	Total	Rp	20,000,000

VIII-2-6 Other matters.

Certificates were handed to the trainees at the end of the training.

VIII-3. Conclusion

This farmers' training at each of the ATA-140 Pilot Tests is highly beneficial to the farmers, particularly in the context of the transfer of technology from the Japanese experts through their respective counterparts. Farmers are very much interested in the training; more than the decided number of 30 people would like to join it if only the accomodation sufficed.

This training has aimed towards integrated agricultural training, with the various subjects given; particularly with the new subject matters and new experiences transferred by the instructors. This kind of training should still be opened in the future, with improvements towards perfection, both in the means and in the method of training.

CHAPTER IX. RECOMMENDATIONS FOR FUTURE DEVELOPMENT

RADP/ATA-140 South Sulawesi
Project Team.

Contents

CHAPTER IX. RECOMMENDATIONS FOR FUTURE DEVELOPMENT

From the study and experience of regional agricultural development planning under the ATA-140 Project, some recommendations can be drawn for future development.

We expect that, in order to maintain the fruits of the project and to develop them further, continuous efforts will be made for further improvement of the policy-making process and the administrative practice, paying due attention to the following recommendations.

IX-1. Recomendations for the Planning in General :

The general method and techniques of planning are mentioned detailfully in " A Guideline for the Regional Agricultural Development Planning " (of which an Indonesian translation is available) and many reports published by the project, so it is deemed unnecessary to reiterate them here.

From now on, quite important is the provision of conditions to make efficient use of such methods and techniques of plan formulation in the practice of administration. From this point of view, authorities concerned are recommended to make careful study of the following points.

IX-1-1. Systematization of planning.

In Indonesia a number of projects have been carried out on the base of several types of plans such as the Five Years' Development Plan, development programs, project plans and annual operational plans.

Although each of the plans has a characteristic in its purpose, content and formulation process, all plans should unitedly aim at an integrated development of agriculture in the region through effective implementation of the projects. In order to keep consistency among these plans, it is necessary to integratedly systematize the process of these planning technically and administratively.

(1). As shown in " A Guideline for the Regional Agricultural Development Planning ", there are many methods of agricultural development planning, according to the nature of the plan. It is a time to prepare the planning method applicable to each plan, taking into consideration the feasibility in administrative practice so that the officials in charge of planning can work out the plan smoothly. This method is a kind of manual, combining the contents, procedure and process in planning, which also expected to contribute to the realization of standardized planning.

(2). Next needed is clarification of the responsibility of administrative organs concerned with planning.
There are many agencies such as the Bureau of Planning and the Directorate of Program Establishment at central level and the Agricultural Regional Office and Agricultural Extension Service and other local agencies at regional level, which are involved in plan formulation and its implementation.
The role and responsibility of each agency should be clearly decided by the office regulation with a respective plan.

IX-1-2. Supplemental measures to strengthen the planning capability.

(1). Inventory of agricultural information.
All officers in charge of planning should prepare an inventory of agricultural information such as land-use, labor force, farming pattern, production and others which are basic materials for the formulation of better plans. At the same time, an inventory of all projects which are going on or which are completed should also be available for their executive agency, site, objective activity, period and so on. A fixed form should be prepared according to the agency or the type of the project.

(2). Development of technology adaptable to local conditions.
Development projects always accompany the introduction of new technology as an important component of the activities. The recommendable technology adaptable for varying local conditions is, unfortunately, not always available with the proposed project. This complicates the formulation of the feasible project. An institutional facility should be established in order to develop the package of technology which can be introduced to farmers' fields with firm confidence promising a greater profit.
In this connection, urgently needed is the so-called A.D.C. (Agricultural Development Center) which is now under consideration by the Government.

(3). Training of officials and farmers.

It is needless to say that no single project can be successful unless it is executed by the personnel with sufficient knowledge and experience. From this point of view, training should be strengthened for the officials and the progressive farmers who are expected to lead the development of the area. This training does not merely aim at disseminating the practical farming techniques but also at equipping the farmers with a complete understanding about the whole process of the projects so that the officials and the farmers can work together to promote agricultural development in the region smoothly.

The training facilities established by the project will be fully utilized, giving the priority to the officials and farmers who are concerned with the projects taken up in the near future.

(4). Strengthen of monitoring.

The goal of the project can only be achieved when all the activities are realized like they are planned. However,many projects show a great gap between the plan and the realization. This may be partly due to the incomplete or unrealistic plan. In order to overcome this problem, the planner should make greater effort to upgrade his capability by looking after the monitoring of the project implementation and grasping the bottleneck in executing the plan.

(5). Budget preparation for the plan formulation.

In view of the significance of planning, a special budget should be provided for the planning activities together with the systematization of planning mentioned in IX-1-1.

It is expected that the position of the Agricultural Regional Office will be placed up in formulating the integrated development plan by being entrusted the allocation of planning budget to the agencies concerned in the province.

IX-2. Recommendations for the Regional Agricultural Development Planning in South Sulawesi :

Having reflected the progress of our project, it is not too much to say that the technological transfer of planning has been achieved fairly well. For example, we are pleased to have heard the reputation that the South Sulawesi regional office prepared the materials for planning best at the meeting for the 4th. 5-year development plan. As nearly all of the counterparts have participated in the JICA training in Japan and also they have learnt the planning method through on-the-job training, now they have understood the planning method theoretically and they can manage somehow to do the paper work of the project formulation. However, they have not gained practical experience in project implementation, as this experience may only be gained when they can be involved once more in an implementative project activity as follow-up of the RADP/ATA-140. It is recommendable to foster them to become capable project managers in the future because the improvement of planning method should be realized in the effect on the project implementation.

The above-mentioned conforms with the system of activity circle of a project team as performed in RADP/ATA-140, including several activities starting from observation, analysis, evaluation, analysis of present situation, project establishment, economization, schedule of the pilot test project, collection of information, review/ observation/ analysis and so on in a circle.

In other words, the planning is the first step for the regional agricultural development and our final benefit can be obtained by the completion of development projects. For the purpose of development itself and training of managers, we recommend that the government will promote the implementation of small-scale agricultural development projects.

During our activities, we have found many project proposals mentioned in the Master Plan of Block III area and we consider that the promotion of small-scale agricultural project is quite practical because such project requires the less fund and the easier technology. As for training, if an officer will participate in one specific project from the beginning till the end performing the work of survey, planning, budgeting, coordination with offices concerned, negotiation with contractors, supervision,etc., he will be sure to have mastered the whole business of agricultural development project. Moreover, if he has a enough knowledge of all the process of project implementation, he will be able to make a better, more practical and more persuasive plan as a planner for the next time.

As for the implementation of the small-scale agricultural project, we recommend that the priority list of project proposals will be made for the annual plan by the joint work of the regional office and DINAS office concerned in each kabupaten. If the financial support will be given to such project proposals in accordance with the priority and the projects will be completed one by one in order, the local people will be rather happy to wait with expectation.

Originally, Pilot Tests in the three fields of citrus, grassland and afforestation were established to provide necessary information for the regional agricultural development planning; therefore, coordination and cooperation must be kept well between the planning agency and the executive agency of Pilot Test. In this connection, we recommend that the regional office will organize some new institution like committee or working group after the termination of our project.

One thing that is most prominent in the implementation of those pilot tests is that two aspects of approach occur which may at the same time support the accomplishment of a good planning as result of the pilot tests, i.e. the approach in research and that in development.

In the field of research, these pilot tests serve as trial tests to gain recommendations, while in the field of development they will be preplanning measures expected to support a steady preparation of software and hardware. Therefore, these pilot tests are equipped with device for practice and training, for people expected to be executives of the development.

Related with the proposal presented by the South Sulawesi Kanwil Deptan Chief, the Governor of South Sulawesi has passed this proposal on the Minister of Agriculture, concerning :

1. The cooperation in Citriculture development;
2. " " " Reforestation in Saddang Watershed area; and
3. " " " Integrated Agricultural Development, as proposal for the implementative project, as follow-up of the RADP/ATA-140 South Sulawesi.

In accordance with the description above, the proposal deserves consideration, in order to take immediate steps enabling the implementation of the proposal, as it is viewed as revelant to the RADP/ATA-140 Project system which has just been executed.

Conforming with the Governor's proposal, the Ministry of Agriculture is expected to immediately prepare a formal proposal to the Government of Japan, so both parties may commence steps in preparation for a new cooperation, to materialize the proposed implementative project.

IX-3. Recommendations for the Management of the Three Pilot Tests :

The main efforts during Phase III of the Project have been focused on the three subsectors of Afforestation, Grassland Improvement and Citrus Improvement, which are given high priority in agricultural development in this region. Therefore we have compiled plenty of suggestions and recommendations in the preceding chapters, namely III-5 (Points at Issue Regarding the Afforestation and Reforestation Project), IV-4 (Possibilities and Points at Issue Regarding Animal Husbandry in Pastures), and V-4 (Points at Issue and Measures to be taken in Citrus Improvement), and it is hoped that these recommendations will be fully utilized for future development after the termination of the ATA-140 Project.

Further, mentioned here are some additional recommendations regarding the management of the three pilot tests which calls for due consideration as soon as possible.

IX-3-1. Afforestation.

Within the period of technical cooperation, trees planted in the Pilot Test have grown only for one or one half year. And as a minimum of 10 years is necessary for the observation of tropical forests, it is essential that the Indonesian side will take full care of this Pilot Test.

For a more efficient use of the Pilot Test, the following additions are recommended :

(1). In the neighborhood of the present 10 ha. of test forest, about 50 - 100 ha. of the experimental and seed forest will be established with some attached facilities like houses for the administration and experiment.

(2). The DAS Saddanf Office is requested to increase the number of specialists to strengthen the activities of data collection, observation, research etc.

IX-3-2. Grassland Improvement.

Through our Pilot Test we have found that the climatic condition at the site is favorable for grass production, but the nutrient in the soil is so scarce that a large quantity of fertilizers is required, which costs quite high. Even if we produce more grass with high expences, such investment cannot be compensated economically unless we gain the benefit by the weight-increase and cattle propagation. In this connection it is recommended that from now on the object of the Pilot Test will be shifted to the study on animal husbandry such as the structure of cattle groups and efficient feeding method.

IX-3-3. Citrus Improvement.

As for the model orchard in Jeneponto, we recommend that the following construction works should be done as soon as possible in order to secure a full capacity of the Pilot Test :

(1). Drinkwater facility;

(2). House for the laboratory and research works (about 300 m2);

(3). Warehouse for the fertilizers and chemicals (about 300 m2);

(4). Small house for the meteorological observation, and

(5). Drainage channels in the fields No. 1, 2, 3 and 5.

LIST OF PERSONNEL IN CHARGE OF THE REPORTING

Composition	:	Isao SUZUKI Koichiro KATSURAI Hideo MIURA Fumiaki HARADA Toshio TAKAKU Mitsuhiko OTA Mono Syamsuddin Onggeng Bachtiar Tadjuddin Dullah Dachlan Noor Dollah Mando L.K. Pong Masak M. Syata Sanusi Yusuf Marzuku Azis Matola Andi Makkasau I. Gd. Md. Suantra Willy Pong Masak
Editing	:	Mitsuhiko OTA
Translation	:	L. Yasin Rachman
Typing	:	1). Intan Djatmiko 2). Diana D. Allus
Auto fax	:	Zainuddin
Printing & Binding	:	M. Said H.S. Syahrullah Naim Zainuddin Hafid
Publishing	:	The ATA-140 Project Team.

June, 1982 - Ujung Pandang.